GUIDELINES ON THE USE OF INDIGENOUS-WESTERN ANTI-HYPERTENSIVE THERAPIES IN BELIZE

By

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SUPERVISOR: **Prof. David Ditaba Mphuthi**

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DEDICATION

The researcher dedicates this work to the Lord Jesus Christ, who gave me life, power, wisdom, and the endurance to go through. I also obligate the research in memories of my late younger sister Deborah Ige Zarafi and my late younger brother Solomon Chiroma Husaini. May your gentle souls continue to rest with Jesus! Amen.

DECLARATION

Student number: **61113271**

I declare that the research on **Guidelines on the use of indigenous-western anti-hypertensive therapies in Belize** is my work. All the sources that I have used or quoted have been indicated and acknowledged by utilizing complete references. This work has not been submitted before for any other degree at any other institution.

I also declare that I have submitted four manuscripts from this thesis for publication.

Danladi Chiroma Husaini

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Full names

……13th September 2020……………

Date

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ABSTRACT

This study's objectives were to identify, describe, and provide guidelines on using indigenous-western antihypertensive therapies in Belize to examine indigenous therapies' efficacy in lowering blood pressure. The researcher utilized an explanatory sequential mixed method research design to examine indigenous-western therapies. Data were collected quantitatively from the general public (n=422) and qualitatively from hypertensive patients (n=24) using indigenous therapies and vendors (n=19) of indigenous therapies. The study results identified 47 different medicinal plants used in the management of hypertension in Belize, as reported by participants. Besides, leaves were the most reported plant part used to manage hypertension, while boiling (decoction) was the most common preparation method. The common route of administration was the oral route, and ½ to 1 cup 2 to 3 times daily was the dose and frequency of administration, respectively. The majority of participants using indigenous therapies did not report side effects. Conversely, orally administered hydrochlorothiazide and captopril were the most common western therapies reported by most respondents in the study. The majority of the respondents did not report concomitant use of indigenous-western therapies to manage their hypertension; however, those who used indigenous therapies reported that medicinal plants were efficacious in lowering their blood pressure. Some of the claims by participants are verified by Western science, thereby authenticating indigenous therapy claims. The researcher developed guidelines on the use of indigenous-western therapies from the results of the study. Collaboration between indigenous healers and Western medical practitioners to provide holistic healthcare approaches was recommended since both sciences have identical foundations and can learn from each other. The government should incorporate indigenous knowledge systems into school curricula.

KEY CONCEPTS

Indigenous therapies, hypertension, Western therapies, indigenous knowledge systems, public health, medicinal plants, herbs, guidelines, concomitant use, Belize.

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CHAPTER 1

ORIENTATION TO THE STUDY

1.1 INTRODUCTION AND BACKGROUND OF THE STUDY

Hypertension is a severe medical condition where blood pressure within the arteries is elevated above normal values. Hypertensive disorders can be classified as either primary or secondary. The majority (95%) of all cases, usually termed primary hypertension, defined as continuous rise of resting systolic blood pressure (≥ 140 mm Hg), diastolic blood pressure (≥ 90 mm Hg), or both, in which there exists no specific identifiable etiology (Bhatt, Kandzari, O'Neill 2014:1393; Bakris 2016:1; Dekker, Amick, Scholcoff, and Doobay-Persaud 2017:171). The other 5% of all cases, classified as secondary hypertension, are caused by some other conditions that affect the kidney, endocrine system, heart, and arteries. Persistent hypertension is among the main risk factors for strokes, heart failure, arterial aneurysm, heart attacks, and chronic kidney failure. A moderate increase in arterial blood pressure results in shortened life expectancy (Dekker et al., 2017:171). Both lifestyle and dietary changes and medicines can help improve blood pressure and reduce the risk associated with health complications from hypertensive conditions.

Evidence from the epidemiological and family studies described by Alicea-Planas, Greiner, and Greiner (2016:43) showed that hypertension occurs from numerous interactions between genetic factors and the environment. These studies have also reported that there exist more than 50 factors that elevate blood pressure. Most important are age, family history of cardiovascular infection, smoking, increased alcohol consumption, a diet rich in cholesterol, sedentariness, and coexistence of some other diseases like diabetes and obesity (Alicea-Planas, Greiner and Greiner 2016:43; Bakris 2016:2).To this end, therefore, proper medication and the adoption of an appropriate lifestyle are essential in preventing hypertension.

The main lifestyle changes that can lower hypertension include reduced body weight in obese patients, low salt intake in the diet, increased physical activity, moderate alcohol consumption, and ceasing smoking (Kieffer 2015:1191; Bakris 2016:2). Appropriate drug treatment is also essential in managing the hypertensive condition. In this case, drug treatment relies on the hypertension stage, the diseases associated with existing hypertension, and the risk factors present. All the recommendations for western hypertensive treatment depend on the classification and definition of hypertension adopted by the Joint National Committee (JNC). JNC is responsible for evaluating, monitoring, documentation, and treating high blood pressure in America (Bidulescu, Francis, Ferguson, Bennett, Hennis, Wilks, Harris, MacLeish, and Sullivan 2015:125). In this case, the committee defined high physiological BP as ≥ 140 mm Hg systolic blood pressure and ≥ 90 mm Hg for diastolic blood pressure.

A rich base of indigenous practices involving the use of spiritism, medicinal plants, and other communal practices has been reported in the Caribbean that is similar to the practices in Belize (Mans 2016:1; Mans, Grant, and Pinas, 2017a:1; Mans, Ganga, and Kartopawiro, 2017b:111). The practices historically are associated with slaves' immigrants from Africa and the native inhabitants of the region. Indigenous therapies are still a common practice by the people of Belize as a holistic approach to managing various diseases. The use of indigenous-western therapies in the management of hypertension in Belize is the focus of this study. Guidelines on such usage shall serve as a guide to the general public on the use of indigenous-western therapies for hypertension and help inform the design, development, and implementation of education to build awareness on indigenous medicinal plants in managing hypertension.

1.2 BACKGROUND TO THE RESEARCH PROBLEM

Hypertension is a significant disorder affecting close to 30% of adults globally, and it is estimated to increase to approximately 60% by 2030. This condition is closely associated with numerous severe health conditions and accounts globally for around 13.5% of all deaths that are premature, 60% of all cases of strokes, and close to 50% of ischemic heart diseases (Xiong, Yang, Liu, Zhang, Wang, and Wang 2013a: 275279; Xiong, Yang, Liu, Zhang, Wang, and Wang 2013b:570). Hypertension causes a severe economic and social burden in both developed and developing countries such as Belize.

In Belize, for instance, hypertension is a significant problem causing high morbidity and mortality rates among the population (PAHO 2009:1; Danladi, Diomar, Roberta, Innocent, and Augustine 2016:357). Developing nations like Belize are experiencing an increase in health burden, where overweight and obesity are becoming very common and exist together with undernutrition and infectious diseases. It is estimated that cardiovascular diseases such as hypertension are some of the leading causes of death in the developing nations (Bidulescu, Francis, Ferguson, Bennett, Hennis, Wilks, Harris, MacLeish, and Sullivan 2015:125).

Belize, as a developing nation, is progressively joining developed countries in the prevalence of non-communicable diseases, especially diabetes and hypertension. As far back as 2009, the Pan American Health Organization (PAHO) reported a rise in the mortality rates and hospitalizations resulting from hypertension and diabetes (PAHO 2009:1). Several modifiable risk factors for developing hypertension as described by other authors (Biraguma, Mutimura, and Frantz 2019:3181; Mishra, Neupane, Shakya, Adhikari, and Kallestrup 2015:863; Shayo 2019:927) are prevalent and on the rise in the country of Belize. Modifiable risk factors such as sedentary lifestyle, low diet, and excessive alcohol consumption are prevalent in Belize, and the attendant observable consequences are already being experienced (PAHO 2009:1; Rosendorff, Lackland, Allison, Aronow, Black, Blumenthal, Cannon, De Lemos, Elliott, Findeiss, and Gersh 2015:1372).

Previously, the incidences of Belize’s infectious diseases have been reported (PAHO 2009:1) to be high. Still, presently, hypertension and diabetes as non-communicable diseases have surpassed infectious diseases, and the number of cases is on the rise. Hypertension is associated with different risk factors such as the non-modifiable and modifiable risk factors (Rosendorff et al. 2015:1372). The non-modifiable factors, in this case, comprise genetics, gender, and age, while the modifiable risk factors include overweight, physical inactivity, and smoking (Schnall, 2016:50). The overall hypertension morbidity and mortality in Belize have been reported (PAHO 2009:1) to rise. In supporting the existence of a high increase in hypertensive mortality in the country, some studies have found increased susceptibility to hypertension (Johnson, Thorpe, Bartels, Schumacher, Palta, Pandhi, Sheehy, and Smith, 2014:65).

The global increase in the awareness of indigenous therapies (primarily herbal) perceived as safe and efficacious simply because they are natural, coupled with the long ancestral history of linkage to African folklore beliefs and practices, has led to people consuming indigenous remedies (Bignante and Tecco, 2013:177; Babu and Antony 2017:1; Mans et al. 2017a:1; Mphuthi and Pienaar 2017:1; Logan, McNairn, Wiart, Crowshoe, Henderson, and Barnabe, 2020). In Belize, for instance, it is a common practice for people to try indigenous remedies before coming to the hospital or combining indigenous therapies with Western medications. With indigenous–western therapies commonly practiced among the Belizean population, hypertensive Belizeans could combine Western pharmaceutical products with indigenous remedies. Without standard guidelines for such usage, indigenous therapies mostly combined with prescribed Western medications could have an unknown beneficial effect or an attendant potential unsafe herb-drug interaction. The behavior could also lead to interactions that might lead to beneficial effects in lowering hypertension, harmful drug-herb interactions, or toxicities. The lack of guidelines from empirical studies on indigenous therapies and documented data on indigenous-western therapies in Belize's country makes the practice a significant concern for public health and health care providers.

Increasing the general awareness, control, and treatment of hypertension is linked to reducing cardiovascular-related infections and total mortality. Using appropriate pharmaceutical drugs and the possible inclusion of indigenous remedies have been reported to ensure that hypertensive related cases are minimized (Popescu, Scrieciu, Mercuţ, Ţuculina, and Dascălu, 2013:1). A major concern for public health might be drug-herb interactions because of western-indigenous practices and their attendant consequences. Although some literature is available on indigenous therapies of Belize, to date, no specific guidelines exist on therapies concerning concomitant consumption with Western drugs (Balick and Arvigo, 2015:22; Kate 2009:120; Arvigo, Epstein, and Yaquinto 1994:190; Ames, Oakes and Correll, 1985:779). Therefore, the present study became very necessary as it seeks to provide detailed information on the use of indigenous-western anti-hypertensive therapies among hypertensive patients in Belize. The study examined the types of indigenous-western anti-hypertensive therapies used by hypertensive patients in Belize, particularly when and how such therapies are used. The research also provides guidelines for western-indigenous antihypertensive usage among hypertensive patients in Belize with a clear view of generating the required data for appropriate interventions designed to curb public health concerns for western-indigenous practices.

1.3 INDIGENOUS THERAPIES

The use of indigenous therapies in treating non-communicable related diseases such as hypertension has been on the rise within the last few decades, with close to 80% of the global population reporting that they had relied on such herbs for their primary healthcare (Ekor 2014:177; WHO 2015:1; Al Disi, Anwar, and Eid, 2016:326). While most indigenous therapies can treat many diseases, and many drugs were discovered from many plants, most such remedies remain untested, with most of their use remained poorly monitored. The resulting consequences of this are inadequate knowledge of their possible efficacies, adverse reactions, their mode of action, possible contraindications, and potential interactions with the already existing Western pharmaceuticals and functional foods that can promote the rational and safety of these herbs (Williamson, Liu and Izzo 2020:1227; Chan, Li, and Perez, 2016:875). Therefore, it is imperative to investigate the indigenous therapies primarily used by hypertensive patients, how they are used, their potential side effects related to such remedies, and measures to address side effects. Since medieval times, indigenous therapies have been prepared using different methods. Whether the treatment is for external or internal use, common preparation methods include decoction, infusions, tinctures, poultices, or salves. In many communities, however, decoctions and infusions are usually the most common preparation methods (Ekor 2014:177).

Beneficial effects could also be experienced by the use of indigenous therapies, especially among hypertensive patients in Belize and the world over. The current increase in indigenous therapies for self-medication by individuals or patients is linked to several reasons. Chanda and Kaneria (2011:1251) enumerated some reasons why people engage in the use of indigenous medicines. Reasons such as patients feeling very uncomfortable talking about their health problems and fear that there will be a lack of confidentiality in handling information related to their health. Additionally, fear of misdiagnosis and subsequent wrong treatment with Western medications, and a lack of enough time for seeing the physician were some of the reasons proffered (Chanda and Kaneria, 2011:1251).

Religion and cultural beliefs also inform the patient's choice to use indigenous therapies, the cost of those herbs, and the perceived efficacy of such herbs in treating the patient's condition (Ekor 2014:177). These herbs are readily available and cheap, making them the first line of treatment in many communities. Besides, indigenous therapies have bioactive phytochemicals used to render health effects. Phytochemical plant constituents such as glycosides, terpenoids, tannins, alkaloids, saponins, flavonoids, phenols, and cardiac glycosides have been reported to provide many health benefits. Many of these phytochemical groups are known individually to have specific health benefits. For instance, flavonoids have antioxidant and antibacterial properties and act as enzyme inhibitors (Moodley, Krisna, Pillay, Sershen, and Govender, 2018:1; Ng, Koick, and Yong 2020:1). A common practice with indigenous therapy is concomitant intake with other medicinal plants or western medications known as polypharmacy. Polypharmacy is described as the concurrent administration of more than one drug or substance for therapeutic purposes (Dookeeram, Bidaisee, Paul, Nunes, Robertson, Maharaj, and Sammy, 2017:1119; Burt, Elmore, Campbell, Rodgers, Avery, and Payne, 2018:91). The practice of polypharmacy is carefully monitored in a clinical setting using carefully designed paper-based or computer software. Although it is much easier to monitor the possibilities of drug-drug interactions in the clinical settings, monitoring for indigenous-western drug interactions is difficult because these interactions have not been scientifically proven. The researcher's view is that it becomes precarious when indigenous therapies are combined with other herbal therapies or indigenous preparations combined with Western therapies. These drug-herb or herb–herb interactions can precipitate toxic effects or, in some instances, render the therapeutic effect of a conventional drug or the more promising herbal preparation more effective (Mphuthi 2015:212; Mans et al. 2017a:1). Unfortunately, few studies thoroughly investigated these interactions between western-indigenous therapies in Latin America and the wider Caribbean (Mans et al. 2017b:111). Therefore, the present study identified and examined the use of indigenous-western anti-hypertensive therapies to provide guidelines on the safe use of indigenous – western therapies in managing hypertension in Belize.

Presently, literature exists that document numerous indigenous therapies used to treat varying diseases in Belize with proven efficacy (Salvamani, Gunasekaran, Shaharuddin, Ahmad, and Shukor 2014:11; Balick and Arvigo, 2015:22; Ames et al., 1985:779; Kate 2009:120; Arvigo et al., 1994:190). However, other than the much-publicized Western drugs for treating hypertension, little is known about Belize's therapies to treat hypertension or indigenous-western combinations in managing hypertension (Mac Arthur, Nelson, and Woodye 2014:1).

In recognition of the importance of medicinal plants in managing various diseases, the Belizean government in 1993 established the world's first medicinal plant reserve, called Terra Nova Medicinal Plant Reserve (TNMPR) in the Cayo district. TNMPR is a 6,000-acre reserve of potentially lifesaving indigenous plants in Belize. Seedling plants "rescued" from rainforest areas in danger of destruction from development are sent to Terra Nova for transplanting. The Belize Association of Traditional Healers manages the reserve (Balick and Arvigo, 2015:15). Despite these efforts, currently, no guidelines exist for indigenous–western remedies used to control hypertension in Belize.

1.4 RESEARCH PROBLEM

Based on the literature above, it is clear that indigenous therapy usage has always been in existence and known by indigenous community members. The indigenous communities still believe and are still practicing the use of indigenous therapies. The practice is well-accepted and promoted among community members, even though Western medical practitioners do not support it. The major non-communicable disease in Belize is hypertension. It causes a substantial economic and social burden to the country and contributes to mortality and morbidity rate. Since time immemorial, native Belizeans depended on the vast rain forest remedies to treat diseases, which is still the practice until today. Belizeans are also using Western and indigenous remedies for treating hypertension, even in this era of western medicines. The problem is that with all the available data on indigenous therapies, presently, there are no guidelines on the use of these therapies in Belize for the management of hypertension. This study evaluated the practice of indigenous–western antihypertensive therapies use among patients to provide guidelines for public safety.

The increase in global usage of indigenous therapies and the rise in the number of people with non-communicable diseases such as hypertension have increased remarkably (Bakris 2016:1; Ekor 2014:177; Mphuthi 2015:213). Belize also sees an increase in the use of indigenous remedies for the treatment of diseases. The use of indigenous therapies to manage varying disease conditions is common in Central America and the Caribbean and is on the increase. Presently, there are no known written guidelines on indigenous-western therapies to manage hypertension in Belize.

Without standard guidelines for such usage, indigenous therapies mostly combined with prescribed Western medications, produce an unknown beneficial effect or potentially unsafe herb-drug interaction. This study seeks to examine the use of indigenous-western anti-hypertensive therapies in Belize to develop guidelines for using these combinations of such therapies.

1.5 RESEARCH AIM/PURPOSE OF THE STUDY

According to Locke, Spirduso, and Silverman (2013:3), the purpose statement indicates why the study should be conducted and what the study intends to accomplish. The purpose statement sets the objectives, intent, or the main idea of a proposal or research. This study identified common indigenous-western therapies used concomitantly to manage hypertension. The study will also provide guidelines on indigenous-western therapies used in the management of hypertension in Belize. Finally, the study aims to provide a list of the commonly used indigenous therapies used in Belize to manage hypertension.

1.6 RESEARCH OBJECTIVES

Based on the aim/purpose of the study above, the following objectives were developed for this study as follows:

1.6.1 Phase 1: Quantitative phase

- To determine the indigenous therapies used by hypertensive patients in Belize to treat hypertensive conditions.
- To identify the common western therapies used in the treatment of hypertension in Belize.
- To identify concomitant use of indigenous-western therapies among hypertensive patients in Belize.

1.6.2 Phase 2 Qualitative phase

- To explore and describe the preparation, storage, and usage of indigenous therapies by hypertensive patients in Belize.
- To understand the concomitant use of indigenous-western therapies by hypertensive patients in Belize.

1.6.3 Phase 3 Guideline development

- To develop guidelines on the use of indigenous-western therapies for the management of hypertension in Belize.

1.7 HYPOTHESIS

Hypotheses are statements in quantitative research in which the investigator makes a prediction or a conjecture about the outcome of a relationship among attributes or characteristics (Creswell, 2015:111). The researcher proposed the following hypotheses to investigate the use of indigenous-western remedies among hypertensive patients in Belize.

- H_I. The use of indigenous-western anti-hypertensive therapies controls high blood pressure compared to single therapy among the Belizean population.
- H_0. The use of indigenous-western anti-hypertensive therapies does not control high blood pressure than the single therapy approach among the Belizean population.

1.8 RESEARCH QUESTIONS

Creswell (2015:111) defined research questions as questions in quantitative or qualitative research that narrow the purpose statement to specific questions that researchers seek to answer. Most studies typically develop research questions before identifying the methods of the analysis. Based on the above study objectives, this study aims to answer the following research questions:

1.8.1 Phase I

- What are the common indigenous therapies used by patients to treat hypertension in Belize?
- What are the common western therapies used by hypertensive patients in Belize?

- Do Belizean hypertensive patients combine indigenous-western therapies in the management of their hypertension?

1.8.2 Phase II

- How are indigenous therapies prepared, stored, and used by hypertensive patients in Belize?
- Why do hypertensive patients in Belize use indigenous therapies?

1.8.3 Phase III

What guidelines should hypertensive patients in Belize use in the management of their hypertension using indigenous-western therapies?

1.9 SIGNIFICANCE OF THE STUDY

A study on indigenous-western therapies in Belize is significant for many reasons. First, identifying the common indigenous-western therapies will help understand the relationship between cultural practices and Western medication use in Belize. Second, presently, there is a paucity of scientific data on the use of indigenous-western therapies; hence, this study's findings may help the medical personnel better understand and approach hypertension management among Belizeans. Third, the study explored adherence to western therapies by hypertensive patients in Belize. Suppose patients use indigenous therapies more than prescribed Western medications. In that case, there is the possibility of wastages of the Western therapies provided to such patients, leading to an overall economic waste of public funds since the western therapies are provided free of charge.

Therefore, this study's results may help health professionals adopt methods to educate their patients on medication adherence. Fourth, the concomitant use of indigenous-western therapies has been reported to produce interactions. Suppose the results of this study showed hypertensive patients combining indigenous–western therapies to manage their hypertension. In that case, the medical personnel will be guided to enlighten their patients on the harms or benefits of such practices. Fifth, many indigenous therapy vendors may be ignorant of current scientific discoveries on numerous plants and herbs claimed to have medicinal properties. The reviewed literature and the results of this study should provide insight into the current scientific efficacies of plants and herbs used by vendors in Belize to manage hypertension. This information will guide vendors in using indigenous therapies that might be useful or harmful in managing hypertension.

Finally, many Western therapies were originally from indigenous knowledge systems. This study's findings may lead to discovering an indigenous therapy that may be effective in managing hypertension not only in Belize but globally. Invariably, this study is significant because it will provide much-needed information for patients, health workers, policymakers at the Ministry of Health, and researchers on indigenous – western therapy practices in Belize.

Summarily this study is critical because:

- This study is envisioned to understand the health impact of indigenous-western anti-hypertensive therapies among the Belizean population.
- The study may resolve theoretical questions regarding the use of indigenous-western anti-hypertensive therapies in Belize.
- The study results will provide guidelines for indigenous-western anti-hypertensive therapies, influencing policymakers to formulate indigenous-western anti-hypertensive therapies for public health.
- The study will support WHO global traditional medicine strategies and Belize's initiative on alternative medicines.
- The study will provide an understanding to support the economic impact of hypertension management using indigenous-western therapies.
- The study will provide the basis for further research on indigenous-western therapies to manage other diseases such as diabetes II.

Proper drug treatment is essential for managing the hypertensive condition. In this case, antihypertensive drug treatment depends on the hypertension stage, comorbidities, and risk factors present. It is assumed that every community has its indigenous drugs for treating conditions such as hypertension. Although hypertension is a major problem in Belize, limited guidelines still exist on the type of indigenous-western anti-hypertensive therapies used among hypertensive patients in Belize. The pattern Belize's hypertensive patients use indigenous therapies to treat their hypertensive condition is of great significance in this study. It aims to offer knowledge and illustrations on the indigenous therapies used to treat hypertension. This study will also attempt to determine how indigenous therapies induce possible drug interactions, possible associated adverse effects, and how they are managed. The study intends to provide guidelines that will help the public and healthcare providers on the use of western-indigenous medications available in Belize. Such guidelines shall provide information on the harms and benefits of western-indigenous antihypertensive practices in Belize. This study's results could be further explored for molecular studies to provide information regarding indigenous therapies that can be synthesized to manage hypertension.

1.10 DEFINITION OF KEY TERMS

1.10.1 Hypertension

Hypertension is sustained elevation of resting systolic BP (≥140 mm Hg), diastolic BP (≥90 mm Hg), or both (Sternlicht & Bakris 2016:139).

1.10.2 Antihypertensive

An antihypertensive agent is a substance that is effective against high blood pressure (Merriam-Webster Dictionary, 2017 Merriam-Webster, Inc.).

1.10.3 Indigenous therapy

Indigenous therapy is the comprehensive knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement, or treatment of physical and mental illness (WHO, 2019).

1.10.4 Western therapies

The use of conventional therapies to help prevent and treat disease. These include lifestyle changes, counseling, medication, physical therapy, or surgery (WHO, 2013).

1.10.5 Vendor

A vendor is a company or person who sells goods or services (Merriam-Webster Dictionary, 2017 Merriam-Webster, Inc.).

1.11 OPERATIONAL DEFINITIONS

Editage insights (2019:1) described operational definitions as a statement of procedures used to define the terms of a process needed to determine the nature of an item or phenomenon. The following operational definitions are used in this study.

1.11.1 Hypertension

In this study, hypertension is a condition of high blood pressure.

1.11.2 Anti-hypertensive

In this study, an antihypertensive is considered a substance, agent, or drug applied by patients to lower high blood pressure.

1.11.3 Indigenous therapies

The knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to Belizean culture, used in the maintenance of health and the prevention, diagnosis, improvement, or treatment of physical and mental illness.

1.11.4 Western therapies

In this study, western therapies are the use of conventional treatments to help prevent and treat disease. These include lifestyle changes, counseling, medication, physical therapy, or surgery (WHO, 2013). These are drugs or medicines given at hospitals or obtained from pharmaceutical shops.

1.11.5 Vendor/Bush doctor

In this study, a vendor (or Bush doctor) is a person who sells or provides indigenous therapies to the public. He is also sometimes called a bush doctor.

1.12 THEORETICAL FRAMEWORK

This study examined indigenous therapies used by traditional healers and hypertensive patients to manage hypertension using the Health Belief Model. The Health Belief Model (HBM) focuses on individuals' beliefs, attitudes, and practices (Becker, 1974:409; Jones, Jensen, Scherr, Brown, Christy, and Weaver, 2014:566). While the model has traditionally been adopted on issues to do with preventive health behaviors, it can be applied to different health contexts, including the use of herbal medicines by indigenous communities (Albashtawy, Gharaibeh, and Alhalaiqa et al., 2016:708; Gyasi, Asante, Abass, Yeboah, Adu-Gyamfi, and Amoah, 2016:1). The model is flexible and suits a variety of contexts, such as its use in the interventions and response of individuals and communities to treat many health conditions (Becker, 1974:409; Fall, Izaute, and Chakroun-Baggioni, 2018:746; Kamran, Sadeghieh, Biria, Malepour, and Heydari, 2014:922). The HBM offered the ground in which this study was conducted. As a general theory, HBM is comprehensive and can be generalized in numerous settings, including indigenous therapies to manage diseases (Albashtawy et al., 2016:708; Gyasi et al., 2016:1; Kamran et al., 2014:922). When people believe that their medical condition is serious, they may use indigenous therapies alone or in combination with Western therapies to explore all possible means of healing either by experience or what they learned from family, friends, and the community.

The argument from the HBM suggests that communities or individuals will take a health-related action such as the use of indigenous therapies to treat diseases if such a community has access to the therapies. They feel that they can avoid negatively related conditions such as side effects or perceived that a more significant benefit occurs in partaking in the new behavior or action (Albashtawy et al., 2016:708). Perception and attitudes have determined how people behave in certain conditions and the resultant practices that ensued. The availability of indigenous therapies within reach of the communities, their prices, and perceived effectiveness influence communities' use of such therapies (Albashtawy et al. 2016:708). In addition, from the HBM model's perspective, each community's uniqueness determines how they respond to different diseases. Environmental factors such as culture, religious beliefs, and psychological interrelationships make up patients' dynamic response to some form of illness (Salvamani et al. 2014:1). Such responses can either act as perceived barriers or perceived promoters of the usage of indigenous remedies. The environment, any external or internal factor in the patient's surroundings, might influence how the patient responds to a given health condition.

The HBM applies well to indigenous healers, and hypertensive patients in Belize continue to use indigenous therapies to manage hypertension. Generally, as outlined in the HBM, people seek therapies depending on the availability of such therapies, perceived usefulness, perceived benefits, perceived effectiveness, and the associated cost. In this regard, indigenous healers and their clients will continue to use indigenous therapies depending on their general knowledge of the therapies, experiences, their perceived effectiveness, and the cost the patients are likely to incur in their quest to find relief from their illnesses (Albashtawy et al. 2016:708). Therefore, indigenous healers and their clients will continue to use indigenous therapies to minimize harmful symptoms from

Western medicines because of their use of indigenous therapies and their perceived cultural effectiveness. Therefore, this research is grounded in the Health Belief Model as it seeks to expound on the use of indigenous anti-hypertensive therapies in Belize.

1.13 RESEARCH METHODOLOGY AND RESEARCH DESIGN

This study utilized mixed-methodology, where both quantitative and qualitative methods were integrated to describe data, while explanatory sequential study design was employed (Creswell, 2015:20). Creswell (2015:20) defined the research design as the specific procedures involved in the research process. These include data collection, data analysis, and report writing. In this study, utilization of indigenous-western therapies was evaluated using a non-experimental, quantitative, and qualitative descriptive design. Descriptive research describes the present status of an identified variable or phenomenon (Creswell 2015:20). This study utilized a mixed-methods explanatory sequential study design under which data were collected using quantitative and qualitative methods described by Creswell (2015:535). The research was divided into three phases, as described below.

In the first phase of the study, quantitative data were collected from hypertensive patients from the entire country of Belize to ensure that the data is an accurate representation of the whole population. The first phase of this study was designed to identify indigenous therapies use by hypertensive Belizeans and if such therapies are concomitantly used with Western medicines.

This phase examined indigenous-western therapies used by Belizeans in the management of hypertension. Data were collected quantitatively utilizing a structured questionnaire. In addition, this phase evaluated the indigenous therapies used individually or concomitantly with Western medicines by the Belizean population.

This study utilized a mixed-methods explanatory sequential study design under which data were collected using quantitative and qualitative methods. Creswell (2015:535) described mixed methods research design as a procedure for collecting, analyzing, and “mixing” through quantitative and qualitative methods in a single study or a series of studies to understand a research problem.

Mixed-methods sequential explanatory design implies collecting and analyzing quantitative and then qualitative data in two consecutive phases within one study (Creswell 2015:535). Using sequential explanatory design, the designer for the study only requires the research investigator to make a general view with regard to some specific aspects of investigations (Ary, Jacobs, Sorensen, and Walker 2014:56). In the explanatory sequential study design, the researcher collects data during the quantitative (numeric) study and analyzes it as a first step to the mixed methods.

1.13.1 Phase I (Quantitative Method) Research Methods

This phase utilized a quantitative research design to identify indigenous medications used by the Belizeans to treat hypertension. Therefore, this study’s first phase identified the indigenous therapies used by hypertensive Belizeans and Western medicines concomitantly used with indigenous therapies.

1.13.1.1 Research Setting

The cultural, physical, social, and environmental sites for which research is conducted is considered the research setting (Creswell 2015:20). The current study on indigenous-western antihypertensive therapies for hypertension was conducted in the entire country of Belize. Belize (formerly British Honduras) is the only commonwealth and English-speaking country in Central America. Its geographical location, historical background, and trade association are Central America and the Caribbean (Figure 3.1). Therefore, the country participates in the activities of the Central American Integration System (CAIS) and the Caribbean Community (CARICOM). It has a total area of about 8, 867 square miles (23,000 km^2) and shares borders with Guatemala (266 km) to the south and west and Mexico (250 km) to the north. It is bordered by the Caribbean Sea to the east, with 386 km of coastline (Figure 3.1). The country has a population of 351,600 (Statistical Institute of Belize [SIB] 2013:1). The main ethnic groups in the country are Mestizo, Creole, Maya, and Garifuna. The literacy rate was 79.7%, with an unemployment rate of 14.2%. Belize is a parliamentary democracy, a member of the Commonwealth, divided into six administrative districts, Belize, Cayo, Corozal, Orange Walk, Punta Gorda, and Stann Creek. The country has a GDP of $1.987 billion (Table 3.1), a GDP growth rate of 0.7%, and an inflation rate of 0.3% (2018). Belize's total exports total for 2018 were estimated at US$200 million annually. The economy's principal sectors are agriculture, agro-processing, and services, primarily tourism (Martin and Manzano 2010:107; Leslie and Heusner 2002:5). The main exports were sugar and molasses (30%), bananas (18.5%), citrus (15.7%), marine products (10.7%), and crude petroleum (6.3%) (SIB 2014:1).

The researcher collected data from major hospitals, clinics, and pharmaceutical outlets in Belize. Hypertensive patients attending special clinics or refilling their orders were identified and targeted for data collection. Data were collected from all six districts of the country. Every confirmed hypertensive patient accessing antihypertensive medications at any healthcare facility qualified to participate in the research.

1.13.1.2 Phase I: Population and sample selection

A population is a group of individuals who have the same characteristic. Simultaneously, a sample is a subgroup of the target population that the researcher plans to study to generalize the target population (Creswell 2015:142). Since the researcher used a non-probability convenient sampling technique for data collection in this phase of the study, the sampling technique allows participants in a given unit to be chosen based on convenience and enable generalization. It has been considered as a useful sampling method that involves receiving relevant information from a sample population that the researcher believes are aware of the matter being investigated. In this case, the study participants were selected based on pragmatic considerations such as their availability and diagnosis during the research. It is important to note that only patients diagnosed with primary hypertension and currently prescribed anti-hypertensive medications were recruited to participate in the study.

Therefore, this study's participants comprised all hypertensive adult patients currently accessing antihypertensive medications at government-owned hospitals, private clinics, or pharmacies. A convenient sampling technique was employed for data collection. An estimated sample size of 422 was used for the study with a 95% confidence level and a +/- 5% confidence interval.

The researcher explained that the study focuses on learning more about indigenous-western therapies among hypertensive patients in Belize. During the survey, the researcher provided participation information sheets explaining the study in written form and an informed consent form with the researcher's contact number. Participants were recruited from the hospitals and pharmacy areas when they refilled their medications or when accessing drugs for hypertension.

1.13.1.3 Sample size and sampling procedures – Phase I

OpenEpi, Version 3, an open-source calculator, was used to calculate the sample size (Dean, Sullivan, and Soe, 2018:1). OpenEpi is a free and open-source software for epidemiologic statistics. It provides statistics for counts and measurements in descriptive and analytic studies, stratified analysis with exact confidence limits, matched pair and person-time analysis, sample size and power calculations, random numbers, sensitivity, specificity and other evaluation statistics, R x C tables, and chi-square for dose-response (Dean et al. 2018:1). The study employed a convenient sampling technique to obtain data from diagnosed hypertensive patients in Belize.

Table 1.1 Phase I sample size calculation using OpenEpi.

Table 1.1 Phase I Sample Size calculation.	
Population size (for Finite Population Correction factor or FPC) (N):	398050
Hypothesized % frequency of outcome factor in the population (p):	50%+/-5
Confidence limits as % of 100 (absolute +/- %) (d):	5%
Design effect (for cluster surveys-DEFF):	1
Confidence level (%)	95%
Sample size	422
Equation: Sample size n = [DEFF*Np(1-p)]/ [(d2/Z21-α/2*(N-1) + p*(1 p)]	

1.13.1.4 Phase I: Sample size calculation

OpenEpi, Version 3, an open-source calculator, was used to calculate the sample size (Dean et al. 2018:1). OpenEpi is a free and open-source software for epidemiologic statistics. It provides statistics for counts and measurements in descriptive and analytic studies, stratified analysis with exact confidence limits, matched pair and person-time analysis, sample size and power calculations, random numbers, sensitivity, specificity and other evaluation statistics, R x C tables, and chi-square for dose-response (Dean et al. 2018:1).

The OpenEpi sample size calculator was used to determine the sample size of 384 x 10% = 422. The addition of 10% was to take into consideration the non-response factor. The final sample size was therefore calculated as 422. The 422 total sample size was further stratified to obtain proportionate samples from the six districts in the country (Table 1.1). A total of 422 questionnaires were used for data collection in this phase of the study. A 95% confidence level with a +/- 5% confidence interval was used to determine sample size. The sample size was determined using Open Epi, Version 3, open-source (Table 1.2). Stratified proportionate samples were further calculated based on the district population, as shown in Table 1.2.

Table 1.2 Sample size per population of each district – Phase I

District	Population	District Sample size
Belize	120, 602	128
Cayo	96,197	102
Orange Walk	51, 749	55
Corozal	48, 429	51
Stann Creek	43, 452	46
Toledo	37, 614	40

A sample size of 422 with a medium effect size at $\alpha = 0.05$ confidence-level was eventually used for the study's first phase.

1.13.1.5 Phase I: Data collection

Creswell (2015:9) defines data collection as a "means of identifying and selecting individuals for a study, obtaining their permission to study them, and gathering information by asking people questions or observing their behaviors."

In this phase, data were gathered from hypertensive patients in Belize using a structured, validated questionnaire. First, the participants were identified, the objectives and significance explained to them, and the researcher addressed any queries. Second, their consent was then sought, and those who gave their permission were informed that participation was voluntary. They were free to withdraw from the research at any point without any penalty or repercussions. The questionnaires were then administered to the participants by the researcher using paper and pencils. Those who could complete the questionnaire without assistance were allowed to do so, while the researcher assisted those who could not. The researcher distributed questionnaires at hospitals and pharmacy outlets throughout the country. Confidentiality and anonymity were strictly applied, and participant identifiers were not required, except if the participants qualified and were willing to participate in Phase II (qualitative) of the study. Finally, the researcher kept the completed questionnaires under lock and key during the entire process.

1.13.1.6 Phase I: Data analysis

Analyzing and interpreting the data involves drawing conclusions about it, representing it in tables, figures, and pictures to summarize it, and to explain the findings in words to provide answers to research questions (Creswell 2015:10). Data coding was done using Statistical Package for the Social Sciences (SPSS) version 21.0 software before being analyzed. Two other reviewers' then cross-checked coded data to ensure that they are consistent, readable, and complete. Mistakes from respondents were checked or corrections made as deemed necessary (Clarke and Braun 2013:120). Descriptive statistics were primarily used to describe demographic data and research questions based on prevalence, and inferential analyses were used to explore relationships.

The main descriptive statistical procedures used were frequencies and percentages, while inferential statistics were used. The responses on indigenous-western therapies were analyzed using version 22 of SPSS (Statistical Package for Social Sciences) (IBM Corp., Armonk, NY, USA). The data were analyzed for frequency counts, and cross-tabulation was performed on associations where needed. The z-score test was used to identify and report statistically significant associations. Prevalence was calculated and reported in terms of 95% confidence interval values. An alpha margin of error (α) was identified at 0.05.

1.13.1.7 Phase I: Data validity and reliability

In its simple definition, validity is the ability of a given research instrument to measure what is supposed to be measured (Elo, Kääriäinen, Kanste, Pölkki, Utriainen, and Kyngäs 2014:1). The validity of this study was assured through some activities. First, the content validity of the instruments was determined by expert judgments. The peer reviews and research supervisor carefully scrutinized the research questionnaire to judge the content's' appropriateness and the need for modification to achieve the study's objectives.

The supervisor determined whether the research instruments' items adequately represented all the areas for investigation.

The well-designed questionnaire was then pretested to ensure coherence and comprehensiveness. The pretest was done for the questionnaires to maximize their relevancy, preciseness, and clarity in answering the required research questions. All ambiguous items not showing were appropriately corrected, replaced, or deleted as appropriate. In addition, research experts, including the research supervisor, were frequently consulted at each stage of the study for corrections and criticism of the tools for data collection (Gysels, Evans, Lewis, Speck, Benalia, Preston, Higginson, 2013:907). This approach aimed to ensure that the study results truly represent indigenous-western anti-hypertensives usage among hypertensive patients in Belize. Similar findings can be obtained even if the study is carried out by another researcher at different times so long as all other factors are kept constant.

Finally, the questions were standardized to ensure that they provided desired answers on indigenous-western antihypertensive therapies. The researcher also ensured the data's validity by administering the questionnaires to all the participants. The reliability of the data was also tested to ensure consistency. Data reliability refers to the extent to which a given study is consistent and stable when the same techniques are applied in a repeated number of ways or the scores from an instrument are stable and consistent (Creswell 2015:159). The primary role of reliability in this study is to minimize biases and errors in the research's conduct.

In this study, the questionnaire was tested for reliability using statistical methods (Bolarinwa 2015:195). Reliability testing of the questionnaire showed a Cronbach's alpha value of 0.779. An exploratory factor analysis (EFA) using principle component analysis extraction and direct oblimin rotation with Kaiser Normalization was also employed, which extracted five components. The Kaiser Mayer Olkin (KMO) measure of sampling adequacy and Bartlett's test for sphericity was also used, which reported a value of 0.6 and a significant *p-value* less than 0.001, respectively.

1.13.2 Phase II: Qualitative method

To understand how the Belizeans use indigenous medications and Western therapies to treat hypertension, this phase used an exploratory, descriptive research design with narration. This phase also explored how indigenous medicines are prepared and stored by the community for use as antihypertensive.

1.13.2.1 Phase II: Research design

A qualitative design was carried out to gain more in-depth insight into how and why Belizeans use indigenous-western therapies to manage hypertension. A qualitative research method was used in the second phase of this study. Creswell (2015:16) describes qualitative research as "an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The researcher builds a complex, holistic picture, analyzes words, reports detailed views of informants, and conducts the study in a natural setting." Qualitative research comprises checking the qualities or characteristics that are not possible to be presented in numerical value. It is a kind of study that has focused on the phenomena that occur within natural settings and comprises studying such phenomena within all the complexity. Creswell (2015:204) further describes qualitative research as comprising doing checks on the qualities or characteristics that cannot be presented in numerical value. Within the context of this study, literature has offered suggestions that systematic and structured approaches are very crucial in tackling the potential causes of undesirable performance for the national culture in animation cinemas (Sandelowski, Voils, Crandell, and Leeman 2013:347).

A qualitative methodology was used in this study to get to know the actual perception of the population sampled concerning the use of indigenous-western anti-hypertensives amongst hypertensive patients in Belize. Similar to any other qualitative research, the study was field focused. Scholarly literatures shows that qualitative studies are usually exploratory and might comprise interviews or focus groups (Wilson 2013:275).

1.13.2.2 Phase II: Population

All hypertensive patients who participate in phase I of the study, willing to participate in the second phase of the study, were invited to participate. Eligible participants were purposively selected from the different districts to participate in the second phase of the research.

The need to get participants from the entire country became paramount because of the diversity in cultural beliefs and usage of indigenous therapies usage. For instance, even though every ethnic group can be found in every part of the country, some ethnic groups are found in higher numbers in some regions of the country. The Garinagu are concentrated in the Stann Creek area, while the Mayans in the far southern part of the Toledo district. The northern part of the country has a higher concentration of Hispanics, while the Mestizos and Creole are in the country's western and eastern regions.

Although the information on indigenous therapies is shared freely among the people, ethnic groups are known to use specific therapies unique to their culture (Balick and Arvigo, 2015:22). The research selected 24 participants from different parts of the country and different ethnicities for the study. Recruitment for the study was done from phase I respondents who indicated using medicinal plants. In addition, indigenous therapies vendors involved in selling indigenous remedies at the market or bush doctors' homes were also used for qualitative data collection. Selection was based on being hypertensive, using indigenous therapies, and willingness to participate in the study.

1.13.2.3 Phase II: Sample and sampling technique

Non-probability purposive sampling was used for this phase, as described by Creswell (2015:324). Data saturation determined the number of participants in this phase. Data saturation is the stage at which no new information is coming during the interview. A total of 24 hypertensive patients were interviewed in the entire country to get diverse and rich responses to indigenous therapies used to manage hypertension. Nineteen indigenous therapy vendors were also interviewed from the whole country. In qualitative research, the people or sites that can best help understand the central phenomenon are selected (Creswell 2015:206). For the second phase of this study, purposeful sampling was used to determine participants for data collection. Participants were selected based on their involvement as vendors for indigenous therapies or as hypertensive patients who used indigenous therapies.

Market places and designated sales points inclusive of the venue for indigenous therapist gatherings were targeted for sample collection. Mark (2010:3) reported that qualitative research is majorly concerned with meaning and not for making generalized statements. Qualitative samples, therefore, must be large enough to ensure that most or all of the perceptions that might be important are revealed. Still, at the same time, if the sample is too large, data becomes repetitive and, eventually, superfluous. The sample size in most qualitative studies should generally follow the saturation concept when the collection of new data does not shed any further light on the issue under investigation. As a result of the numerous factors that can determine sample sizes in qualitative studies, many researchers shy away from suggesting what constitutes a sufficient sample size. Although the idea of saturation is helpful at the conceptual level, it provides little practical guidance for estimating sample sizes for robust research before data collection" (Mark 2010:3). Mark (2010:3) further reported that other researchers have tried to suggest guidelines for qualitative sample sizes. Charmaz (2006:114) suggests that "25” participants are adequate for smaller projects, while Ritchie, Lewis, and Elam (2003:84), indicated that qualitative samples often "lie under 50". Green, Judith, and Thorogood (2004:120) stated that "the experience of most qualitative researchers is that in interview studies little that is 'new' comes out of transcripts after you have interviewed 20 or so people" (Mark 2010:3). While some researchers offer qualitative sample guidelines, there is evidence that suggests others do not strictly adhere to them. Creswell (2015:128) suggested a range of 20 and 30. Therefore, based on the above, this study purposively selected 24 participants from indigenous therapy users for hypertension and 19 vendors of indigenous therapies in Belize.

1.13.2.4 Phase II: Data collection

Creswell (2015:218) defined one-on-one interviews as a data collection process. The researcher asked questions and recorded answers from only one participant in the study at a time. On the other hand, a focus group interview collects data through interviews with a group of people, typically four to six. Information regarding usage and interactions should be obtained from the patients using face-to-face interviews. The interviews were designed to explore why and how often patients use indigenous remedies to treat their hypertension.

Data were collected from indigenous therapy vendors and hypertensive patients using structured face-to-face interview guides in this phase. The research supervisor and other researchers critiqued the questions to ensure trustworthiness. Two sets of data were collected in this phase.

Data were first collected from hypertensive patients using indigenous therapies. The participants were identified during phase I of the study. The patients were contacted at their place of residence. Based on the earlier relationship developed and consent received during phase I of the study, the participants were included in the phase II study. Although consent was sought during the first phase of the study, consent was still sought during the qualitative data collection phase. Strict ethical protocols were observed during the entire process of data collection. The researcher conducted interviews in a place and at a time convenient for the participants, with field notes taken for responses from the participants.

The second set of data for this phase were also collected from indigenous therapy vendors. Purposively identified in market places and within the communities were interviewed after their consent was sought. The researcher conducted interviews based on the convenience of indigenous therapy vendors. These sections of the study explored and described the sources of indigenous therapies and how they were prepared, used, and stored by the vendors for use as antihypertensive therapies.

Interviews used for data collection brought salient issues on indigenous-western therapies to light. A qualitative interview occurs when researchers ask one or more participants general, open-ended questions, and record their answers. The researcher then transcribed and typed the data into a computer file for analysis (Creswell 2015:217). Available information regarding indigenous remedies used to treat hypertension and their efficacy were obtained from indigenous vendors using one-on-one interviews.

1.13.2.5 Phase II: Data analysis

Responses from structured and unstructured qualitative interviews were entered into a computer coded, counted, and analyzed. Creswell (2015:245) describes a computer analysis of qualitative data as a means that researchers use a qualitative computer program to facilitate the process of storing, analyzing, sorting, and representing or visualizing the data. Data collected during in-depth interviews with hypertensive patients were transcribed, read several times, and their themes were coded in line with the study objectives.

In transcribing the information, performing categories of the critical dimensions of summaries and associations were also strategic for data analysis. Additionally, a thematic analysis is aided and presented in a thematic network form that provided a general outline of the key themes generated from a given dataset (Elo et al., 2014:1). As quoted in the literature, the thematic analysis helped enhance understanding of some given phenomenon. It promoted accurate interpretation of the data collected during fieldwork, leading to more in-depth explorations and more explanations. Themes with similar codes aggregated together to form a central idea in the database (Creswell 2015:245).

This researcher’s primary study focus was to explore indigenous-western anti-hypertensive therapies among hypertensive patients in Belize. Therefore, a combination of both categorical and holistic strategies was essential for this research. The researcher first made the analysis quantitatively by collecting data on indigenous-western therapies using questionnaires. Then, qualitatively analyzed data on indigenous-western therapies from vendors and patients interviews were determined using categorical strategies. The kind of categories initiated in this case acted as a guide for analysis.

For the purpose of revealing the general perception of the patients and vendors regarding the concomitant usage of indigenous-western therapies, a holistic analysis is more appropriate, especially after developing categories since the researcher can narrate the perception of individual respondents and compare it with the observed behaviors in that respect as outlined by Clarke and Braun (2013:120). They reported that the two analysis strategies are not by any chance exclusive of one another.

1.14 PHASE III: DEVELOPMENT OF THE GUIDELINES

Guidelines on the use of indigenous-western anti-hypertensive therapies were developed at the end of phase 2 of the study. In developing these guidelines, this study adapted the principles of triangulation to combine the quantitative data with the qualitative data to produce the guidelines used of indigenous-western antihypertensive therapies among Belizeans. Such guidelines included part of the plants used for hypertensive management and how to process the indigenous remedy. In addition, Western medications commonly prescribed for hypertensive therapy were documented, including concomitant use with indigenous therapies.

Guidelines for the use of indigenous-western hypertensive therapies were established based on the explanatory sequential mixed-methods design. Creswell and Plano-Clark (2018:54) described an explanatory sequential mixed-methods design consisting of collecting quantitative data and then collecting qualitative data to explain or elaborate on the quantitative results. This approach’s rationale was that the quantitative data and results provide a general picture of the research problem; more analyses, specifically qualitative data collection, helped refine, extend, or explain the general concept. In this method, Creswell (2015:542) further classified three ways to mix the data from an explanatory sequential method. First, the priority of quantitative data (QUAN) collection and analysis are given by introducing it early in the study and having it represent a significant aspect of data collection. A small qualitative (qual) component typically follows in the second phase of the research. Second, quantitative data were first collected in the sequence, followed by secondary qualitative data collection, presented in two stages, with each phase identified in headings on the report. Third, the qualitative data are used to refine the results from the quantitative data. Refinement of the results leads to exploring a few typical cases, probing a key result in more detail, or following up with an outline.

The merging or mixing of the data shall be done by triangulation. Creswell (2015:542) described triangulation “as a means that investigators could improve their inquiries by collecting and integrating different kinds of data bearing on the same phenomenon.” The three points to the triangle are the two sources of the data and the phenomenon. This improvement in inquiries would come from blending one type of method’s strengths and neutralizing the other’s weaknesses. This study adapted the principles of triangulation to combine the quantitative data with the qualitative data to produce the guidelines used of indigenous-western antihypertensive therapies in Belize. Such guidelines included part of the plants used for hypertensive management, how to process the indigenous remedy, the recommended dosage, how the therapies should be taken, and reported adverse effects or interactions when used with Western medicines.

This phase of the study provided the guidelines for public safety and health care professionals. The phase also offered useful suggestions for future investigations into the use of indigenous-western therapies in Belize.

1.15 SCOPE AND LIMITATIONS OF THE STUDY

This research was delimited to hypertensive patients in Belize only. Moreover, only patients found during the time of the study were involved as study participants. All ethnic groups in the country of Belize were eligible and were included in the study. Some participants from the local communities did not speak fluent English, which created a sort of barrier in data collection during both phases of the study. However, this limitation was overcome by the help of other health professionals who provided excellent interpretation.

The researcher visited some homes more than once to interview participants, which increased the research cost.

1.16 STRUCTURE OF THE DISSERTATION

The research study shall be organized according to the following pattern:

Chapter 1: Orientation to the study

Chapter 2: Literature review

Chapter 3: Research design and method

Chapter 4: Analysis, presentation description of the research findings

Chapter 5: Integration of research findings and the development of guidelines.

Chapter 6: Conclusions and recommendations

1.17 SUMMARY

Currently, hypertension is one of the leading causes of morbidity and mortality in Belize. A chunk of the government's budget is spent purchasing medications and losing the workforce with huge economic burdens to the nation. The other non-communicable disease is diabetes. This chapter presented a general outline for research on indigenous-western antihypertensive usage among Belizean people. The purpose, objectives, and broad background of the study are presented in this chapter.

Hypertension is a significant disorder affecting close to 30% of adults globally, and it is estimated to increase to around 60% by 2030. Being a major problem in Belize, the condition is associated with numerous other health problems in the communities.

In addition to lifestyle modifications, different Western medicines exist in the treatment and management of hypertension. However, currently, no guidelines exist regarding the indigenous-western remedies for use among Belizeans.

Belize, as a country, is blessed with rich rain forest and the locals, with great success, have used indigenous therapies to cure many diseases. To date, the rich availability of indigenous therapies in the country of Belize has not been fully explored, even though the indications of such successes are very evident in many communities.

The results generated from this study intend to validate claims by vendor's hypertensive patients on indigenous therapies used by locals to lower blood pressure. Evidence exists on many indigenous remedies used for the management of several diseases. Further research could lead to discovering an antihypertensive drug from Belizean indigenous herbs that could be patented. Therefore the study shall provide the Ministry of Health with guidelines for public use of indigenous-western therapies among hypertensive patients.

The study's primary focus was to identify and provide guidelines on popular indigenous remedies used concomitantly and non-concomitantly in hypertension therapy in Belize. The study, therefore, investigated the use of indigenous-western antihypertensive therapies among hypertensive patients in Belize.

CHAPTER 2

LITERATURE REVIEW

2.0 INTRODUCTION

The previous chapter highlighted the general study overview of indigenous-western antihypertensive therapies usage in Belize. This chapter focuses on the literature review described in the following paragraph. Creswell (2015:80) described the literature review as a written summary of journal articles, books, and other documents that describe the past and current state of information on the topic being researched. It also organizes the literature into subtopics and documents the need for a proposed study. In the most rigorous research form, researchers base this review mainly on research reported in journal articles. However, a good review might also contain other information drawn from conference papers, books, and government documents (Creswell, 2015:80). In reviewing the literature for this study, reported journal articles, books, online blogs, dissertations, magazines, and newspapers were extensively consulted and reviewed for useful information on hypertension, western antihypertensive medications, and indigenous remedies used in the management of hypertension.

2.1 HYPERTENSION

According to Bakris (2016:1), hypertension, defined or described as a sustained elevation of resting systolic blood pressure (≥140 mm Hg), diastolic BP (≥90 mm Hg), or both. The World Health Organization (WHO) reported that cardiovascular diseases (CVD) are the leading cause of morbidity and mortality globally, and by extension, a significant public health problem in many countries (WHO 2013a:1, 2013b:1). The risk factors for CVD are sedentary lifestyle, smoking, diabetes, hyperlipidemia, and hypertension. In 2013, the WHO reported that hypertension was implicated as the most common factor that triggers CVD and becomes even more debilitating when comorbid with other CVD risk factors (WHO 2013a:317). In the same document, hypertension has also been reported to be accountable for approximately 16.5% of annual deaths worldwide.

A study conducted in 2010 by Kizhakekuttu and Widlansky (2010:20) reported hypertension as the leading cause of morbidity and mortality related to cardiovascular diseases. Worldwide annual death toll from hypertension has been estimated to rise to a staggering 23.5 million people by 2030 (WHO 2013a:317). In addition to all these, hypertension can lead to other debilitating diseases such as dementia, damage to the kidneys, or blindness. Furthermore, the onset of diseases such as coronary heart disease, heart failure, atherosclerosis, peripheral artery disease, and stroke has also been attributed to hypertension as a significant liable player (Freedman and Cohen 2016:1607). Currently, Bakris (2016:1) reported that about 75 million people have hypertension in the United States of America alone, of which 81% are cognizant that they have hypertension. Of this percentage, 73% are undertaking therapy, with only 51% having adequate control of their blood pressure. The morbidity and mortality rates of hypertension have been reported to be greater in blacks who have higher rates of diagnosed hypertension with 41% than whites and Mexican Americans, who have 28% each.

Hypertension, therefore, has been defined as a sustained elevation of resting systolic blood pressure (≥140 mm Hg), diastolic BP (≥90 mm Hg), or both (Bakris, 2016:1; Weber, Schiffrin, White, Mann, Lindholm, Kenerson, Flack, Carter, Materson, Ram, Cohen, Cadet, Jean-Charles, Taler, Kountz, Townsend, Chalmers, Ramirez, Bakris, Wang, Schutte, Bisognano, Touyz, Sica, and Harrap, 2014:3). Primary hypertension (formerly called essential hypertension) is the most common and has no known singular cause. Secondary hypertension (hypertension with an identified cause) is usually a result of chronic kidney disease or primary aldosteronism.

2.1.1 Types of hypertension

Primary and secondary hypertension is the most commonly described types of hypertension (Bakris 2016:1). Although primary hypertension is the focus of this research, secondary hypertension is also described below.

2.1.1.1 Primary hypertension

Although other types of hypertension have been identified and described, 85-95% of people with clinically reported hypertension cases are primary. Physiologic and hemodynamic factors vary, indicating that a single cause is unlikely in primary hypertension's etiology (Bakris, 2016:1). Even if a single etiological factor is initially identified as responsible for developing primary hypertension, multiple factors are always involved and work together to sustain high blood pressure. Age, diet, obesity, stress, malfunction of ion pumps, lifestyle, neuro-humoral activity, and hereditary have all been implicated as predisposing factors that can lead to primary hypertension development. Difficulty in ascertaining or establishing the etiological factors for primary hypertension makes it more challenging to manage (WHO 2013a:1; Bakris, 2016:1; Singh, Shankar, and Singh, 2017).

2.1.1.2 Secondary hypertension

On the other hand, secondary hypertension affects 5 – 10% of hypertensive individuals globally, and the causes are identifiable with relatively higher chances of therapeutic success than primary hypertension. The most common cause of secondary hypertension is primary aldosteronism. Other identifiable causes of primary hypertension are diabetes, renovascular diseases, renal parenchymal disease, pheochromocytoma tumor, hyperthyroidism, coarctation of the aorta, Cushing syndrome, myxedema, and adrenal hyperplasia. Common causes of curable secondary hypertension are the use of oral contraceptives and excessive use of alcohol. Drugs such as cocaine, sympathomimetics, corticosteroids, and NSAIDs have been reported to commonly contribute or worsen control of high blood pressure (WHO 2013a:1; Bakris, 2016:1). A higher risk stage of hypertension is indicated with every increase of 20/10 Systolic blood pressure (SBP) /diastolic blood pressure (DBP) (SBP/DBP) mmHg; a reading of 140-159/90-99mmHg is considered stage I, while stage II is ≥160/≥100mmHg, which usually requires immediate medical attention (Weber et al., 2014:3).

Presently, the American Society of Hypertension (ASH) and International Society of Hypertension (ISH) (Weber et al., 2014:3) consider individuals with a blood pressure of 120– 139/80–89mmHg pre-hypertensive. Pre-hypertensive individuals are usually three times more likely to become hypertensive later in life than normotensive individuals, and this needs to be taken into consideration when considering targeted therapeutic measures. For the general population, the Eighth Joint National Committee (JNC 8) on hypertension recommended pharmacological treatment be initiated at an SBP of 150mmHg or DBP of 90mmHg. Treatment is usually initiated when blood pressure values of SBP and DBP reach 140 or 90mmHg or higher in patients diagnosed with chronic kidney disease (CKD) (James, Oparil, Carter, Cushman, Dennison-Himmelfarb, Handler, Lackland, LeFevre, MacKenzie, Ogedegbe, Smith, Svetkey, Taler, Townsend, Wright, Narva, and Ortiz, 2014:507; Al Disi et al., 2016:326).

Additionally, age is considered a severe predisposing factor in the development of hypertension because the increase in age increases blood pressure, and two-thirds of individuals greater than 65 years have been diagnosed with hypertension. A 90% lifetime risk of developing hypertension exists in people aged 55 with normal blood pressure, such that age-related increases in blood pressure have become common and mostly appearing harmless. Overall, higher increases in blood pressure in the elderly increase the chances of higher morbidity and mortality. Pregnancy-induced hypertension has also been reported (Bakris, 2016:1).

2.2 PATHOPHYSIOLOGY OF HYPERTENSION

Several factors that characterize the pathogenesis of hypertension are discussed below. Derangement of the arteries in the vascular tree affects the conduit of large arteries such as the aorta, small resistance arteries of sizes between 150 and 400µm, and arterioles and capillaries that make up the micro-circulation conduit. Increased peripheral resistance resulting from vascular smooth muscle cells' proliferation, for instance, decreases arterial diameter, leading to hypertension. Many plants and herbs tend to modify blood pressure by favorably modulating vascular smooth muscles (Al Disi et al., 2016:326).

Furthermore, increased sensitivity and potency of the arteries result from enhanced basal and activated calcium levels due to overactive transmembrane calcium permeability via calcium channels, dysregulation of endothelial pro-oxidant enzymes, nitric oxide synthase, inclusive of the coexistence of cellular vascular smooth muscle hypertrophy and hyperplasia. Individually and collectively, these factors work to bring about increased vasoconstriction. Additionally, an increased ratio of vessel wall thickness can result from these pathological events. Compared to the arterial lumen dimension, the increased ratio of arterial vessel wall thickness plays a significant role in precipitating hypertension (Al Disi et al., 2016:326).

2.2.1 Vascular smooth muscle cell (VSMC) proliferation

A decrease in the diameters of arteries leads to increased peripheral resistance. Increased resistance in the periphery reduces vascular smooth muscle cells' multiplication and contributes to hypertension's pathogenesis. Growth factors such as visfatin, fibroblast growth factor (FGF), and platelet-derived growth factor (PDGF) stimulate or inhibit vascular smooth muscle cell growth. Cyclic guanosine monophosphate (cGMP) and nitric oxide (NO) have been reported to be vascular smooth muscle relaxants (Al Disi et al., 2016:326). To a large extent, the determinants of vascular smooth muscle cell phenotypes are usually a balance between anti-proliferating signals and proliferative signals, and several herbs and plants studied favorably modulate vascular smooth muscle cells to ameliorate the increase in blood pressure (Lacolley, Regnault, Nicoletti, Li, and Michel, 2012:194; Miao and Li, 2012:643; Al Disi et al. 2016:326).

2.2.2 Endothelial Cells

The endothelial cell layer plays an essential role in many homeostatic regulations of the cardiovascular system. The regulation of smooth muscle cell proliferation and vascular tone is brought to the release of vasoactive substances. In addition, the vascular endothelium is stimulated by circulating cells to release vasodilators such as prostacyclin and nitric oxide and vasoconstrictors such as thromboxane and endothelin, leading to increased production of reactive oxygen from an imbalance between vasoactive agents, which can lead to dysfunction of the endothelium resulting in hypertension. Finally, modification therapy with indigenous herbal remedies could reverse the endothelia's derangement (Virdis and Taddei 2011:167; Montezano and Touyz 2012:87; Silva, Pernomian, and Bendhack, 2012:441).

2.2.3 Signaling Molecules

Several studies have reported that many plants and extracts of herbs and their metabolites modulate a cascade of signals implicated in cardiovascular system physiology. These plants and herbs with their metabolites have the potential to reverse a diverse range of hypertensive pathophysiologies in addition to their ability to protect the vasculature, especially when early diagnoses indicate a lack of decompensated state in hypertensive patients (Montezano, Dulak-Lis, Tsiropoulou, Harvey, Briones, and Touyz, 2015:631; Niture, Khatri, and Jaiswal, 2014:36).

2.2.4 Reactive oxygen species (ROS)

Reactive chemical species such as peroxides and hydroxyl radical superoxides comprising oxygen referred to as reactive oxygen species (ROS) (Hayyan, Hashim, and AlNashef, 2016). Pathological states such as hypertension, atherosclerosis, and other vascular diseases arise when the balance between antioxidants and pro-oxidants is disturbed. In the pathogenesis of hypertension, ROS play an essential role in creating an environment of oxidative stress. Hydroxyl ions (OH -) and superoxide anions and (O•− 2), for instance, are major reactive oxygen species that are involved in the pathogenesis of hypertension (Montezano et al. 2015:631). The reactivity of nicotinamide-adenine dinucleotide phosphate (NADPH) oxidase inclusive of numerous enzymatic reactions, especially reactions related to the electron transport chain inside the mitochondria, adds to cellular environmental oxidative stress. An increase in reactive oxygen species concentration reduces intracellular endothelial antioxidant levels, indicating oxidative stress. In contrast, vascular smooth muscle remodeling and endothelial cell dysfunction from oxidative stress lead to decreased nitric oxide bioavailability. Furthermore, enhanced proliferation and inflammation have been reported to significantly activate plaque development, which results in increased blood pressure (Montezano et al. 2015:631). Hence, a reduction in blood rodents' pressure due to the blockage of reactive oxygen species exposed to antioxidants. By up-regulating antioxidant enzymes through the Keap1-Nrf2 pathway, numerous phytochemicals suppress oxidative stress (Tao, Zheng, Lau, Jaramillo, Chau, Lantz, Wong, Wondrak, and Zhang, 2013:631; Niture et al. 2014:36; Hayyan et al. 2016)

2.2.5 Nitric oxide

Among key vascular health indicators, nitric oxide has often been accepted as the most important. Due to its ability to dilate vessels, nitric oxide plays a crucial role in inhibiting aggregation of platelets, multiplication of vascular smooth muscle cells, and physiological regulation of blood pressure (Zeng, Villar, Yu, Zhou, and Jose, 2009:157; Francis, Busch, Corbin, and Sibley, 2010:525). Nitric oxide is synthesized from l-arginine by nitric oxide synthases (Francis et al. 2010:525); its release and subsequent translocation into the vascular smooth muscle cells bring about the activation of soluble guanylate cyclase, leading to the catalytic conversation and cyclization of guanosine triphosphate to cGMP (Francis et al. 2010:525). With nitric oxide, the modulation of calcium levels and the resultant contraction of vascular smooth muscle cells are brought into cGMP binding to the cGMP-dependent protein kinase. The production of peroxynitrite due to nitric oxide reacts with superoxide anions occurs within seconds of nitric oxide production, precipitating oxidative stress while reducing the vasodilation effect of nitric oxide (Drummond, Selemidis, Griendling, Sobey, 2011:453). Therefore, nitric oxide's bioavailabilityNADPH oxidase levels depend on the concentration of reactive oxygen species; hence, vascular tone and endothelial dysfunction result from the interplay between nitric oxide and its bioavailability (Montezano and Touyz, 2012:87).

2.2.6 Hydrogen Sulfide

In a few animal studies, a positive correlation has been reported between hydrogen sulfide deficiency and the pathogenesis of hypertension (Benavides, Squadrito, Mills, Patel, Isbell, Patel, Darley-Usmar, Doeller, and Kraus, 2007:17977; Liu, Lu, Hu, Wong, Webb, and Bian, 2012:141). Endothelial cells and vascular smooth muscles potentially produce hydrogen sulfide by the enzyme cystathionine γ-lyase through the catalysis of l-cysteine (Calvert, Coetzee, and Lefer, 2010:1203; Pan, Liu, Gong, Yang, and Zhu, 2012:106). Opening ATP-dependent potassium channels, increasing intracellular levels of cGMP leading to vasorelaxant effects on vascular smooth muscle cells at the cellular and molecular levels has been reported to be with hydrogen sulfide (Bucci, Papapetropoulos, Vellecco, Zhou, Zaid, Giannogonas, Cantalupo, Dhayade, Karalis, Wang, Feil, and Cirino, 2012:e53319) and opening ATP-dependent potassium channels (Banerjee, Maulik, Mancahanda, Dinda, Gupta, and Maulik, 2002:1509; Calvert et al. 2010:1203; Bucci et al. 2012:e53319; Pan et al. 2012:106). Hydrogen sulfide has also been reported to diminish vascular smooth muscle cell proliferation, depress angiotensin II and angiotensin-converting enzyme levels, reduce reactive oxygen species, induce nitric oxide synthesis, prevent vascular inflammation, and potentiating antioxidant mechanisms (Calvert et al. 2010:1203; Pan et al. 2012:106; Benavides et al. 2007:17977).

2.2.7 Rennin angiotensin mechanism

The renin-angiotensin-aldosterone system plays a crucial role in regulating blood pressure (RAAS) (Nguyen and Touyz, 2011:2141; Hall, do Carmo, and da Silva, 2019:2; Santos, Oudit, Verano-Braga, Canta, Steckelings, and Bader, 2019:H959). The secretion of renin in response to a decrease in cardiac output activates the renin-angiotensin-aldosterone system. Renin, in turn, catalyzes the conversion of angiotensinogen to angiotensin I, which is cleaved to form angiotensin II by the angiotensin-converting enzyme. Vasoconstriction and the promotion of sodium and water retention leading to angiotensin II-mediated hypertension are enhanced by binding to the angiotensin I type receptor. Angiotensin II also enhances aldosterone production and stimulation of NADPH oxidase, which generates reactive oxygen species (Song and Zou 2012:1607; Hall et al. 2019:2).

Additionally, the elevation of cardiac output and increase in peripheral vascular resistance brought about by the stimulation of the sympathetic nervous system activity through angiotensin II precipitates the pathogenesis of hypertension (Bernstein, Ong, Blackwell, Shah, Giani, Gonzalez-Villalobos, Shen, Fuchs, Touyz, 2013:1; Santos et al. 2019:H959). Other elements such as inflammation, hydrogen sulfide, and reactive oxygen species contribute to hypertension's pathogenesis (Al Disi et al., 2016:326; Hall et al. 2019:2; Kitt, Fox, Tucker, and McManus, 2019:44).

2.2.8 Nuclear Factor Kappa B (NF-κB)

Vascular remodeling and consequent hypertension development due to inflammation have been reported (Vazquez-Prieto, Rodriguez, Lembo, Galmarini, and Miatello, 2011:475216; Petrie, Guzik, and Touyz, 2018:575; Grillo, Salvi, Coruzzi, Salvi, and Parati, 2019:1970). Transcription factors such as nuclear factor B (NF-κB), is active in the pathogenesis of hypertension. Through the release of pro-inflammatory cytokines such as interleukin-6 and tumor necrosis factor-alpha, NF-κB has been reported to induce oxidative stress, endothelial cell dysfunction, and inflammation (Li and Zhuo 2008:37; Kang, Ma, Zheng, Elks, Sriramula, Yang, and Francis, 2009:503; Petrie et al. 2018:575; Grillo et al. 2019:1970). Increased renal injury and hypertension have been reported as a result of increased expression and activation of nuclear factor kappa B (Elks, Mariappan, Haque, Guggilam, Majid, and Francis, 2009: F298). Several factors can induce the activation of NF-κB. Reactive oxygen species, tumor necrosis factor-alpha, and angiotensin II can activate NF-κB (Petrie et al., 2018:575). Angiotensin II-induced pressor response is attenuated by NF-κB, and angiotensin I receptor regulation (Vazquez-Prieto et al. 2011:475216; Bhatt, Lokhandwala, and Banday, 2014:367; Luo, Wang, Wang, Chen, Wang, Xu, Chen, and Zeng, 2015:76; Petrie et al. 2018:575). Additionally, stimulation of the expression of vascular cell adhesion molecule-1 (VCAM-1) decreased apoptosis of endothelial cells as well, and increased proliferation has all been reported as a function of NF-κB (Vazquez-Prieto et al. 2011:475216; Jiang, Qi, Zhang, Gu, Yan, Shen, Yao, Kong, Chien, and Jiang, 2013b:e56076; Petrie et al. 2018:575; Grillo et al. 2019:1970).

2.3 PHARMACOLOGICAL MANAGEMENT OF HYPERTENSION

Many drugs are now available for the management of hypertension, and depending on the stage of hypertension or race of the individual, some cocktails are at the physician's disposal to choose. Diuretics such as hydrochlorothiazide are usually the first line of treatment for most patients at the beginning of hypertension. Other classes of drugs are β-adrenergic blockers (atenolol), renin inhibitor (Aliskiren), Calcium Channel Blockers (Verapamil, Nifedipine), Angiotensin Receptors Blockers (Losartan), α-adrenergic blockers (Prazosin), angiotensin-converting enzymes inhibitors (ACEI) (enalapril); sympathoplegic agents (clonidine, reserpine), and direct-acting vasodilators (minoxidil, nitroprusside sodium). Newer and more specific drugs are being designed to manage hypertension, and therapy is now majorly evidence-based (James et al. 2014:507; Al Disi et al. 2016:326).

With the availability of numerous drugs for managing hypertension, as shown in Table 2.1, many patients diagnosed with hypertension do not have their blood pressure under control. In the US, for instance, out of the 73% undertaking therapy, only 51% have adequate control of their blood pressure (Bakris 2016:1). Lack of blood pressure control in many patients has been attributed to a number of factors ranging from reduced patient compliance, higher cost of treatment, availability, accessibility of drugs, the undesirable adverse effects of the medications, and perception by patients about antihypertensive drugs. Considering all these factors, therefore, patients diagnosed with hypertension in the third world countries, especially from rural communities, will not hesitate to seek unconventional approaches, such as indigenous medicinal therapies, to manage their hypertensive conditions and possibly other diseases.

Table 2.1 Oral antihypertensive drugs

Drug Class and Trade Name	Mechanism of Drug Action	Usual Dose Range in mg/Day	Usual Daily Frequency*
Thiazide diuretics Thiazide diuretics exert their diuretic effect via blockage of the sodium-chloride (Na/Cl) channel in the distal convoluted tubule's proximal segment, leading to increased Na/Cl and water excretion.			
chlorothiazide (Diuril)		125–500	1–2
chlorthalidone (generic)		12.5–25	1
hydrochlorothiazide (Microzide, HydroDIURIL†)		12.5–50	1
polythiazide (Renese)		2–4	1
indapamide (Lozol†)		1.25–2.5	1
metolazone (Mykrox)		0.5–1.0	1
metolazone (Zaroxolyn)		2.5–5	1
Loop diuretics Loop diuretics induce its effect by competing with chloride to bind to the Na-K-2Cl (NKCC2) cotransporter at the apical membrane of the thick ascending limb of the loop of Henle and blocking the cotransporter, which inhibits the reabsorption of sodium and chloride			
bumetanide (Bumex†)		0.5–2	2
furosemide (Lasix†)		20–80	2
torsemide (Demadex†)		2.5–10	1
Potassium-sparing diuretics Prevent sodium reabsorption in the collecting tubule by binding ENaCs			
amiloride (Midamor†)		5–10	1–2
triamterene (Dyrenium)		50–100	1–2
Aldosterone receptor blockers			

Interferes with sodium reabsorption by competitively inhibiting the action of aldosterone in the distal tubule, thus promoting sodium and water excretion and increasing potassium retention			
eplerenone (Inspra)		50–100	1
spironolactone (Aldactone†)		25–50	1
Beta-Blockers Block beta receptors in the heart leading to negative chronotropic and inotropic			
atenolol (Tenormin†)		25–100	1
betaxolol (Kerlone†)		5–20	1
bisoprolol (Zebeta†)		2.5–10	1
metoprolol (Lopressor†)		50–100	1–2
metoprolol extended-release (Toprol XL)		50–100	1
nadolol (Corgard†)		40–120	1
propranolol (Inderal†)		40–160	2
propranolol long-acting (Inderal LA†)		60–180	1
timolol (Blocadren†)		20–40	2
Beta-Blockers with intrinsic sympathomimetic activity	Block beta receptors in the heart leading to negative chronotropic and inotropic		
acebutolol (Sectral†)		200–800	2
penbutolol (Levatol)		10–40	1
pindolol (generic)		10–40	2
Combined alpha- and Beta Blockers	Block beta receptors in the heart leading to negative chronotropic and inotropic and vasodilation		

carvedilol (Coreg)		12.5–50	2
labetalol (Normodyne, Trandate†)		200–800	2
Angiotensin-Converting Enzyme Inhibitors (ACEI) ACE inhibitors produce vasodilation by inhibiting the formation of angiotensin II.			
benazepril (Lotensin†)		10–40	1
captopril (Capoten†)		25–100	2
enalapril (Vasotec†)		5–40	1–2
fosinopril (Monopril)		10–40	1
lisinopril (Prinivil, Zestril†)		10–40	1
moexipril (Univasc)		7.5–30	1
perindopril (Aceon)		4–8	1
quinapril (Accupril)		10–80	1
ramipril (Altace)		2.5–20	1
trandolapril (Mavik)		1–4	1
candesartan (Atacand)		8–32	1
eprosartan (Teveten)		400–800	1–2
irbesartan (Avapro)		150–300	1
losartan (Cozaar)		25–100	1–2
olmesartan (Benicar)		20–40	1
telmisartan (Micardis)		20–80	1
valsartan (Diovan)		80–320	1–2
Calcium Channel Blockers (CCBs)—non dihydropyridines Decrease systemic vascular resistance by relaxing smooth muscles, which lowers arterial blood pressure			
diltiazem extended-release (Cardizem CD, Dilacor XR, Tiazac†)		180–420	1
diltiazem extended-release (Cardizem LA)		120–540	1

verapamil immediate-release (Calan, Isoptin†)		80–320	2
verapamil (Coer, Covera HS, Verelan PM)		120–360	1
Calcium Channel Blockers (CCBs) —dihydropyridines Decrease systemic vascular resistance by relaxing smooth muscles, which lowers arterial blood pressure			
amlodipine (Norvasc)		2.5–10	1
felodipine (Plendil)		2.5–20	1
isradipine (Dynacirc CR)		2.5–10	2
nicardipine sustained-release (Cardene SR)		60–120	2
nifedipine long-acting (Adalat CC, Procardia XL)		30–60	1
nisoldipine (Sular)		10–40	1
Alpha-1 blockers Block alpha one receptors leading to vascular smooth muscle			
doxazosin (Cardura)		1–16	1
prazosin (Minipress†)		2–20	2–3
terazosin (Hytrin)		1–20	1–2
Central alpha-2 agonists and other centrally acting drugs Stimulate central alpha 2 receptors leading peripheral vascular smooth muscles relaxation			
clonidine (Catapres†)		0.1–0.8	2
clonidine patch (Catapres-TTS)		0.1–0.3	1 weekly
methyldopa (Aldomet†)		250–1,000	2
reserpine (generic)		0.1–0.25	1

guanfacine (Tenex†)		0.5–2	1
Direct vasodilators Directly cause smooth muscle relaxation by relaxing the capillaries.			
hydralazine (Apresoline†)		25–100	2
minoxidil (Loniten†)		2.5–80	1–2

Source: JNC 7, 2004:1

2.4 MEDICINAL PLANT MODULATION OF BLOOD PRESSURE

Medicinal plants contain bioactive substances, especially antioxidants capable of modulating blood pressure (Anwar, Al Disi, and Eid, 2016:50). The ability of medicinal plants to influence blood pressure are discussed in this section.

2.4.1 Introduction

With the global increase in diagnosed individuals suffering from cardiovascular diseases, the need and demand for cost-effective therapeutic products that are safe, efficacious, readily available, and accessible are also rising. With the availability of clinically-oriented research providing shreds of evidence of proven records of numerous phytochemicals that provide prevention and treatment of diverse diseases and ailments, many patients with cardiovascular diseases are gradually turning to medicinal plants and herbs to find effective means of managing their diseases. Besides, conventional medicines are not affordable for some patients, not easily accessible, or do not adequately respond to the medications. Alongside this trend, the search for affordable indigenous remedies with fewer adverse effects that are easily accessible and available is gaining slow but sure grounds as many herbal remedies are presently incorporated into evidence-based healthcare practice (Weber et al. 2014:3; Al Disi et al. 2016: 326).

2.4.2 Medicinal plants used for hypertension

Ever before the emergence of modern medicines, people used indigenous therapies to treat their diseases. Presently, over a hundred active compounds have been scientifically identified as drugs from plants alone (Helmenstine, 2019:1). An increasing amount of literature exists on medicinal plants and herbs used for the management of hypertension. Some of the herbal therapies have gone through extensive studies with many reported discoveries about their bioactive metabolites. Other plants are still being investigated, and new information on their pharmacology and toxicities has been revealed. Below is a list of some of the reported medicinal plants and herbs documented for use in hypertension.

Numerous factors have led to a substantial global increase in medicinal herb usage. Foremost among them is that herbal remedies are inexpensive compared to conventional drugs and have fewer adverse effects. The World Health Organization (2014:4) reported that this increase in patronizing herbal remedies is not necessarily dependent on the country, region, or economic status of the individuals, since complementary and alternative medicines are now used by over 70% of people in developed countries for the prevention or treatment of various ailments and diseases. The trend is not any less in developing countries where a more pronounced usage of alternative medicines is being recorded (WHO 2014:4; Onyebode, Kandala, Chilton, and Lilford, 2016:984).

Throughout human history, medicinal plants and herbs have been used to prevent and treat many ailments and diseases; hence, their importance must in medicine (Table 2.2). The Chinese Unani Tibb medicine and Ayurvedic medical practices, for instance, have most of their origins from plants or herbal-based extractions. Today, many such formulations are still used in the management of various diseases. Summarily, the history of use of diverse medicinal plants with successes and the clinically proven efficacy of several plant extracts explains in part the continued global interest and increased utilization of these products for therapeutic purposes (Pan, Zhou, Gao, Yu, Zhang, and Tang, 2013:627375; Weber et al. 2014:3). Herbal therapies are presently in high demand in many countries because of their perceived safety, fewer adverse effects, effectiveness, and low cost. These remedies are readily available, easily accessible, and natural, perceived to have no harm are growing with increasing popularity the world over (Oga, Sekine, Shitara, Toshiharu-Horie, 2015:0296).

The use of plant and herb extracts for medicinal purposes is termed herbal medicine or indigenous therapies. For the most part, herbal therapies are unlike pharmaceutical products because they are made up of mixtures of highly complex chemical components that are yet to be characterized but whose bioactive constituents are efficacious medicinally (Oga et al. 2015:0296). Due to their perceived safety, fewer adverse effects, effectiveness, and low cost, herbal therapies are presently in high demand in many countries. These remedies are readily available, easily accessible, and natural, perceived to have no harm are growing with increasing popularity the world over.

Consequently, indigenous therapies from medicinal herbs have a long history of use even before discovering conventional therapies. With advances in clinical studies, these herbal therapies are becoming increasingly valuable in preventing and treating various diseases, making them more established, especially with overall improvements in quality control and analytical advancements (Calixto, 2000:179). For instance, it has been reported that dependence on indigenous and medicinal plants has increased significantly by about 80% in many developing countries. In many developing nations, indigenous medicines and herbal therapies are mainly a substantial source of primary health care. Herbal therapies are currently not only utilized by developing countries; instead, the trend has shown a global increase in awareness and usage of the products (Mahady, 2001:1120S; WHO 2008:1). According to reports, there is presently an active reliance on natural and complementary therapies to prevent or manage many ailments in Germany, where over 75% of the population use the products (Tuffs, 2002:325). The report further indicated that as many as 70% of the country's physicians prescribe indigenous herbal medicines to their patients for diverse ailments (Tuffs, 2002:990).

Furthermore, even in countries with a highly developed healthcare system like the United States of America, the population is slowly reverting to organic and natural therapies due to discontentment with prescribed conventional drugs, which are becoming costlier by the day. This trend has led to increased research into natural products, emphasizing delivery, safety, and efficacy (Tachjian, Tachjian, Maria, and Jahangir, 2010:515). On the other hand, countries like Japan have made significant progress in traditional and herbal medicine research and usage with over 148 different medicinal plants listed on the Japanese National Health Insurance Drug Tariff alone. Among those listed, Japanese medical practitioners prescribe medicinal therapies to over 78% of their patients to prevent and treat various diseases (Komiya, Watanabe, and Fuse, 2011:15; Moschik, Mercado, Yoshino, Matsuura, and Watanabe, 2012:139818). Compared to conventional therapies, increased utilization of medicinal plants has been attributed to increased perceived safety because they are obtained from natural sources. They are cheaper and, for the most part, with reported efficacy and low incidence of side effects than Western drugs (Zhang 1998:45).

Table 2.2 List of drugs derived from plants.

Drug/Chemical	**Action**	**Plant Source**
Acetyldigoxin	Cardiotonic	Digitalis lanata (Grecian foxglove, woolly foxglove)
Adoniside	Cardiotonic	Adonis vernalis (pheasant's eye, red chamomile)
Ajmalicine	Treatment for circulatory disorders	Rauvolfia sepentina
Convallatoxin	Cardiotonic	Convallaria majalis (lily-of-the-valley)
Deserpidine	Antihypertensive, tranquilizer	Rauvolfia canescens
Deslanoside	Cardiotonic	Digitalis lanata (Grecian foxglove, woolly foxglove)
Digitalin	Cardiotonic	Digitalis purpurea (purple foxglove)
Digitoxin	Cardiotonic	Digitalis purpurea (purple foxglove)

Digoxin	Cardiotonic	Digitalis purpurea (purple or common foxglove)
Ephedrine	Sympathomimetic, antihistamine	Ephedra sinica (ephedra, ma huang)
Gitalin	Cardiotonic	Digitalis purpurea (purple or common foxglove)
Lanatosides A, B, C	Cardiotonic	Digitalis lanata (Grecian foxglove, woolly foxglove)
Ouabain	Cardiotonic	Strophanthus gratus (ouabain tree)
Protoveratrines A, B	Antihypertensives	Veratrum album (white false hellebore)
Pseudoephredrine	Sympathomimetic	Ephedra sinica (ephedra, ma huang)
nor-pseudoephedrine	Sympathomimetic	Ephedra sinica (ephedra, ma huang)
Rescinnamine	Antihypertensive, tranquilizer	Rauvolfia serpentina
Reserpine	Antihypertensive, tranquilizer	Rauvolfia serpentina
Rhomitoxin	Antihypertensive, tranquilizer	Rhododendron molle (rhododendron)
Scillarin A	Cardiotonic	Urginea maritima (squill)
Tetrandrine	Antihypertensive	Stephania tetrandra
Theobromine	Diuretic, vasodilator	Theobroma cacao (cocoa)
Theophylline	Diuretic, bronchodilator	Theobroma cacao and others (cocoa, tea)

Source: Taylor, Rabe, McGaw, (2001:1)

Although herbal therapies use is grossly rising in many countries, and approval for their usage is gaining wide acceptance, the story is different in other countries where rigorous regulative obligations make it challenging and sometimes difficult for herbal medications to be registered. Therefore, the stringent regulatory requirements in such countries limit the opportunity for the use of medicinal herbs. For instance, herbal medicines in the

United Kingdom have been viewed with reservation and seen suspiciously as therapies that are likely to cause peculiar health challenges to the public. Because of this perception, many consultations between indigenous medicine practitioners and physicians are being conducted to ensure public safety while being careful not to deny the benefits derived from such products (Walker, 2015:1; Boyle, Doolan, Andrews, and Reid, 2011:951).

Furthermore, about 50% of synthesized pharmaceutical products evolved from medicinal plants and other natural products, and the discovery of conventional drugs from plants and herbs is still ongoing, with great success being recorded (Table 2.2). It is a fact that drugs like ephedrine (Ephedra sinica), reserpine (Rauwolfia serpentina), atropine (Atropa belladonna), lovastatin (Monascus purpureus), digitoxin/digoxin (Digitalis purpurea), aspirin (Salix alba), vincristine (Catharanthus roseus), etoposide (Podophyllum peltatum), emetine (Cephaelis ipecacuanha), artemisinin (Artemisia annua) and quinine (Cinchona) were derived from indigenous therapies (Pan et al. 2013: 627375). One effective drug in treating hypertension is reserpine, obtained from a medicinal plant; reserpine produces its action by depleting adrenergic neurotransmitters in the central nervous system (Weber et al. 2014:3). Throughout human history, medicinal plants and herbs have been used to prevent and treat many ailments and diseases; hence, their importance in medicine (Newman and Cragg 2012:311; Lahlou 2013:17; Katiyar, Gupta, Kanjilal, Katiyar, 2012:10).

Table (2.3) below illustrates some of the medicinal plants tested for their effects on blood pressure. These medicinal plants are not limited to the ones being discussed here.

Table 2.3 Commonly used medicinal plants for the treatment of blood pressure

Medicinal plant name	Commonly used parts	Method of preparation	Effect on blood pressure	Participants	Side effects
Coriandrum sativum (Cilantro or Coriander)	Leaves Seed	Water, alcohol extracts	Hypotension	Rats, rabbits	None reported
Bidens pilosa L. (Beggar's Tick, Black-Jack)	Leaves	Methanol, Water	Hypotension	Rats	None reported
Zingiber officinale (Ginger)	Roots	Powder Water	Hypotension	Rats, humans	None reported
Allium sativum (Garlic)	Bulb	Powder Water extract	Hypotension	Humans, rats	Heartburn, acid reflux, abdominal swelling, and flatulence
Camellia sinensis (Green Tea)	Leaves	Hot water, infusion	Hypotension	Rats, humans	None
Hibiscus sabdariffa (Roselle)	Calyx	Infusion,	Hypotension	Rats, Humans	None
Crataegus spp. (Hawthorns	Leaves, bark	Water and alcohol extract	Decreased weight, Improve	Rats, Humans	None reported

or thorn apple)			kidney function		
Cymbopogon citratus (Lemongrass)	Leaves	Boiling	Smooth muscle relaxation	Winstar rats	None reported
Andrographis paniculata (King of Bitter)		Water extraction	Smooth muscle relaxation	Winstar Rats, Mice	None reported
Apium graveolens (Celery)	Stem	Water and ethanol extraction	Hypotension	Winstar Rats	None reported
Coptis chinensis (Chinese Goldthread)	Roots, leaves, and stem	Boiling, decoction	Hypotension	Winstar Rats	Hypotension
Panax (Ginseng)	Roots, leaves, and stem	Boiling and sniffing	Hypotension	W,instar rats	Excitement and increased libido

Source: *Al Disi et al., 2016:326*

Based on table 2.3 above, most medicinal plants are mainly prepared by boiling or alcohol extraction. The commonly used parts are roots and leave either green or dry. Most of the experiments were done on rats and mice. Many of the reported medicinal plants did not present significant side effects. The common side effects reported were mild hypotension, heartburn, acid reflux, abdominal swelling, and flatulence. Table 2.3 presents a summary of the various studies conducted and the mechanism of blood pressure-lowering effect by medicinal plants (Al Disi et al. 2016:326).

2.4.2.1 Coriandrum sativum (Cilantro or Coriander)

Cilantro has been established and used the world over both as a culinary ingredient (Anilakumar, Khanum, and Bawa 2010:9; Wu, Tsai, Yao, Lii, Chen, and Wu, 2010:1846) and for the indigenous management of both gastrointestinal and cardiovascular disorders (Jabeen, Bashir, Lyoussi, and Gilani, 2009:123). Presently, no clinical trials have been reported that considered the effects of cilantro on blood pressure (Al Disi et al. 2016:326). However, cilantro has been shown to have antioxidant properties (Cioanca, Hritcu, Mihasan, and Hancianu, 2013:193; Ramkissoon, Mahomoodally, and Ahmed, Subratty 2013:561). Increased antioxidant enzymes from cilantro's leaves and seed powder have been reported to have a potent effect on the antioxidant GPX (Anilakumar et al. 2010:9). Inactivation of β-adrenoceptor-induced ROS production and the prevention of myocardial infarction by inhibiting myofibrillar damage was also reported in an isoproterenol-induced myocardial infarction (MI) model of cardiotoxicity using cilantro's extracts (Patel, Desai, Gandhi, Devkar, and Ramachandran, 2012:3120). Other researchers have reported similar effects of cilantro's antioxidant activities and its vasodilatory effects (Cioanca et al. 2013:193; Ramkissoon et al. 2013:561). For instance, in normotensive Sprague-Dawley rats, a dose-dependent fall in SBP, DBP, and mean arterial blood pressure (MABP) was reported after intravenous application of an aqueous methanolic extract of dried, ground coriander seeds (1–30mg/ml) (Jabeen et al. 2009:123). Dose-dependent relaxation of pre-constricted (phenylephrine and potassium chloride) rabbit aortas was also described with cilantro's fruit extracts in the same study (Jabeen et al., 2009:123). The described response in those studies was atropine - and calcium-channel-dependent. In addition to this, the diuretic effects of cilantro's extracts were further reported to act in synergy with cilantro's vasoactive constituents to complement the treatment and management of high blood pressure (Jabeen et al. 2009:123). Furthermore, Wu et al. (2010) reported the inhibitory effects of cilantro in reducing the activities of NF-κB and iNOS. Additionally, the same extracts showed diuretic effects as well, depicting the active component that acts synergistically with the vasoactive constituent to complement the treatment and management of hypertension (Jabeen et al., 2009). Finally, coriander acts as an inhibitory agent to reduce the activities of NF-κB and iNOS (Wu et al. 2010:1846).

2.4.2.2 *Bidens pilosa L. (Beggar's Tick, Black Jack)*

Bidens pilosa has been reported to have both anti-cancer, anti-malarial, and anti-obesity properties, in addition to exhibiting antihypertensive effects (Bartolome, Villaseñor, and Yang, 2013:340215). Although extracts of *B.pilosa* leaves were shown to prevent and attenuate high blood pressure in different rat models and normotensive Wistar rats, no clinical trials have been conducted to determine the potential effect of *B.pilosa* on hypertension (Bartolome et al. 2013:340215; Al Disi et al. 2016:323). The methanol leaf extracts of *B.pilosa* showed a reduction in systolic blood pressure by 17 and 21% in fructose-fed rats after 6h treatment with 75 and 150mg/kg.respectively. Furthermore, *B.pilosa* leaf extracts showed preventive effect on SBP by 9 and 11% at 75 and 150mg/kg, respectively (Bartolome et al. 2013:340215; Dimo, Rakotonirina, Tan, Azay, Dongo, and Cros, 2002:183; Al Disi et al. 2016:323).

Interestingly, reports on insulin sensitivity in *B.pilosa* have been shown to conflict. Whereas Bartolome et al. (2013:340215) reported improved insulin sensitivity, Dimo et al. (2002:183), reported no effect observed on plasma insulin sensitivity. Although to date, the mechanism of vasodilation with *B.pilosa* has not been completely deciphered, studies on its vasorelaxant effects showed a general agreement among researchers (Bartolome et al. 2013:340215; Dimo et al. 2002:183; Al Disi et al. 2016:323). *B.pilosa's* scavenging abilities have also been reported with crude extracts which are isolated phytochemicals and fractions (Bartolome et al. 2013:340215). Potent anti-inflammatory effects via inhibition of the pro-inflammatory transcription factor, NF-κB was reported with luteolin (a flavonoid) and ethyl caffeate (ester of hydroxycinnamic acid), both phytochemicals of B.*pilosa* (Xagorari, Papapetropoulos, Mauromatis, Economou, Fotsis, and Roussos 2001:181).

2.4.2.3 *Zingiber officinale (Ginger)*

Ginger is a common ingredient used to season food or for general culinary purposes in many homes. Ginger has been reported to reduce blood pressure mainly from its bioactive constituents, namely (6)-gingerol and (6)-shogoal (Mao, Xu, Cao, Gan, Corke, Beta, and Li, 2019:185). Triphasic blood pressure profiles (initial rapid fall, intermediate rise, and finally a delayed decrease in BP) as a result of administration of oral (70-140mg/kg) or intravenous (1.75-3.5mg/kg) of two bioactive constituents of ginger, namely (6)-gingerol and (6)-shogoal was demonstrated in a clinical study (Suekawa, Ishige, Yuasa, Sudo, Aburada, and Hosoya, 1984:836; Mao et al. 2019:185). Castro, Lorenzo, González, and Cruzado (2010:781) reported (6)-gingerol as a potent angiotensin II type 1 receptor blocker. Inhibition of angiotensin-converting enzyme (ACE) and lipid peroxidation in rat hearts has been demonstrated (Akinyemi, Ademiluyi, and Oboh, 2013:641). Potent scavenging of oxidant molecules like peroxynitrite has been reported with zingerone, another active compound found in ginger (Shin, Kim, Chung, and Jeong 2005:7617). Akinyemi, Ademiluyi, and Oboh (2014:317) recently reported ginger extracts to inhibit ACE-1 activity while reducing levels of LDL, total cholesterol, vLDL, and triglycerides. Ginger will continue to be used as an ingredient for most culinary purposes (Mao et al., 2019:185).

2.4.2.4 Allium sativum (Garlic)

Garlic has been reported to have anti-inflammatory, hypocholesterolemic, anti-cancer, antibacterial, hypotensive, and antioxidant properties, and its healing abilities have been reported in various cultures over a thousand years (Chan, Mclachlan, Luca, and Harnett, 2020:100292). In many developed and developing countries, physicians and clinical researchers are continuing in their efforts to investigate the numerous claims made regarding the multi-fold healing powers of garlic (Qidwai and Ashfaq, 2013:125649; Chan et al. 2020:100292).

Ried, Frank, and Stocks (2013:64) reported that individuals using garlic for medicinal purposes or spices consume either the extract, powder, oil, or raw form. The pungent smell of garlic limits raw consumption in some individuals; hence, many enteric-coated supplements that dissolve quickly in the gastrointestinal tract are available for ease of consumption (Chan et al., 2020:100292). Reports by Qidwai and Ashfaq (2013:125649) and Chan et al. (2020:100292) indicated that the number of people treating their hypertension with garlic is high, and interest in its use on the rise. The major bioactive organo-sulfur substances reported in garlic are diallyl disulfides (DADS), methyl thiosulfonate, Sallylcysteine (SAC), diallyl trisulfides (DATS) and Allicin (Qidwai and Ashfaq 2013:125649), which produce its unique mechanisms of action. Although garlic is presented to be potentially effective in many health situations, and its use has found global acceptance, numerous pharmacologic mechanisms of action for hypotension have been reported based on the constituents identified (Shouk, Abdou, Shetty, Sarkar, and Eid, 2014:106). For instance, reduction in systolic blood pressure or diastolic blood pressure only has been reported in some studies, while no change in blood pressure or significant lowering of blood pressure was reported in other studies (Augusti, Jose, Sajitha, and Augustine, 2012:6; Oga et al. 2015:24; Chan et al. 2020:100292). Despite the irregular reported effects of garlic and its constituents, the induction of its hypotensive abilities has been confirmed in many studies (Chan et al. 2020:100292). Various garlic types have been reported to lower systolic, diastolic, or both blood pressure in an extensive review (Barnerjee et al. 2002:1509). In the same vein, garlic was reported (Qidwai and Ashfaq 2013:125649; Chan et al. 2020:100292) to have an efficacy of almost 80% anti-hypertensive herb.

Consistency in reducing high blood pressure by aged extract of garlic as compared to other forms of garlic was evident, as reported in a few meta-analyses studies. More recently, for instance, a significant lowering of systolic (by 3.75mmHg) and diastolic (by 3.39mmHg) blood pressures was reported in a randomized, controlled trial with garlic supplement (Wang, Yang, Qin, Yang, 2015:223). When compared to placebo, a significant (4.6 ± 2.8mmHg) lowering of systolic blood pressure was observed in another meta-analysis on randomized, controlled trials (Ried et al. 2013:64). Similarly, a 12-week treatment with 960mg/day aged garlic extract given to persons with uncontrolled high blood pressure (≥140mmHg) in a double-blind, parallel randomized placebo study showed a systolic blood pressure of up to an average of 10.2 ± 4.3mmHg (Ried et al. 2013:64). Ried et al. (2013:64) further reported that the more stable S-allylcysteine commonly exhibited such an effect than allicin.

Furthermore, Ashraf, Khan, Ashraf, and Qureshi (2013:859) reported a significant lowering of systolic (9.2mmHg) and diastolic (6.27mmHg) blood pressures in another randomized, parallel, placebo-controlled trial where stage 1 hypertensive patients were administered 300–1500 mg/day tablets of garlic for 24 weeks. Greater antioxidant potency was reported in aged extracts of garlic compared to other garlic derivatives (Mathew and Biju, 2008:65; Chan et al. 2020:100292). An increase in cellular antioxidants was seen when aged extracts of garlic lead to potent scavenging of reactive oxygen species (Drobiova, Thomson, Al-Qattan, Peltonen-Shalaby, Al-Amin, and Ali 2011:703049; Morihara, Hayama, and Fujii 2011:17). In addition, a 50% reduction in systolic blood pressure raised the levels of antioxidants by over 60% when 500mg/ml garlic aqueous extracts were used to treat two-kidney, one-clip hypertensive rats for three weeks in a comparable study (Drobiova et al. 2011:703049).

The ability of aged garlic extracts to scavenge superoxides was not only demonstrated in rats but equally reported in human neutrophils (Morihara et al., 2011:71). Vazquez-Prieto et al. (2011:475216) reported a reduction in NADPH oxidase levels in fructose-fed rats' aorta after daily administration of 150 or 400mg/kg garlic extracts. Furthermore, garlic's antihypertensive properties have been reported to be mediated by endogenous signaling gases such as nitric oxide and hydrogen sulfide (Banerjee et al. 2002:1509; Mousa and Mousa 2007:119; Ried et al. 2013:64; Chan et al. 2020:100292), where a significant decrease of 17mmHg in SBP was reported in stage I hypertensive patients administered 2600mg of garlic for ten days (Mousa and Mousa 2007:119). Interestingly, garlic extracts have also been shown to increase the bioavailability of nitric oxide by 200% (Mousa and Mousa 2007:119), increased hydrogen sulfide production and induces its synthesis for vasorelaxant activity (Benavides et al. 2007:17977); increased expression of Connexin-43 (Cx43), a gap junction protein correlated with a reduced VSMC proliferation and DNA synthesis (Joshi, Martin, Shaver, Madamanchi, Muller-Borer, and Tulis, 2012:220), and inhibition of ACE (Sendl, Elbl, Steinke, Redl, Breu, and Wagner, 1992:1). Inhibition of vascular smooth muscle cell proliferation, reduction in angiotensin II-induced vasoconstrictor responses, abrogation of the activation of NF-κB, and inhibition of endothelin-1 induced vasoconstriction have all been reported with garlic (Banerjee et al. 2002:1509; Castro et al. 2010:781; Pan, Liu, Gong, Yang, and Zhu, 2012:106).

Few side effects have been reported with garlic, regardless of the diverse therapeutic effects on hypertension. Heartburn, acid reflux, abdominal swelling, and flatulence have been reported with garlic (Yang, Chan, Hu, Walden, Tomlinson, 2011: 397136; Ried et al. 2013:64; Chan et al. 2020:100292).

2.4.2.5 Camellia sinensis (green tea)

Deka and Vita (2011:136) reported that camellia sinensis has anti-cancer, antibacterial, antidiabetic, anti-inflammatory, and antihypertensive effects (Al Disi et al. 2016:323). Camellia tea was also reported to be the most frequently consumed beverage worldwide (Faria, Papadimitriou, Silva, Lopes de Faria, and Lopes de Faria, 2012:1838; Peng, Zhou, Wang, Yu, Yang, and Liu, 2014:6251). Different researchers have presented conflicting reports on the antihypertensive effect of *C. sinensis*. For instance, earlier reported data (Hodgson, Puddey, Burke, Beilin, and Jordan, 1999:457; Hodgson, Puddey, Burke, Watts, and Beilin, 2002:195; Peng et al. 2014:6251) showed an increase in blood pressure after 30 min of C. *sinensis* consumption with a return to baseline readings after 60 min. Nagao, Hase, and Tokimitsu (2007) reported decreased systolic blood pressure in patients with 140mmHg or higher values. Meta-analysis studies also showed varying blood pressure effects among participants given *C.sinensis* (Peng et al. 2014:6251). Taubert, Roesen, and Schömig (2007:626) reported no change in blood after drinking C. *sinensis* in a meta-analysis of five trials. However, Peng et al. (2014:6251) demonstrated a reduction in both systolic (1.98mmHg) and diastolic (1.92mmHg) blood pressure in a meta-analysis study of randomized controlled trials. Other studies tend to agree with reducing both systolic and reduce blood pressure due to C.*sinensis* consumption (Bogdanski, Suliburska, Szulinska, Stepien, Pupek-Musialik, and Jablecka, 2012:421; Hodgson, Puddey, Woodman, Mulder, Fuchs, and Scott 2012:186). Compared with black tea, green tea induced a more potent antihypertensive effect, especially with long-term consumption (Al Disi et al. 2016:323). Different catechins have been described as the major flavonoids found in green tea. Deka and Vita (2011:136) reported epicatechin (EC), epicatechin-3-gallate (ECG), epigallocatechin (EGC), and epigallocatechin-3-gallate (EGCG) as the major catechins found in green tea. The primary catechins predominant in green tea were reported to be EGCG (Babu and Liu 2008:1840; Faria et al. 2012:1838; Slevin, Ahmed, Wang, McDowell, and Badimon 2012:1186; Thomson, Al-Qattan, Mansour, and Ali 2012: 409047).

Vasorelaxant effects have long been reported as responses to flavonoids. Ras, Zock, and Draijer (2011:e16974) reported flow-mediated dilation, while Oyama, Maeda, Kouzuma, Ochiai, Tokimitsu, and Higuchi (2010:578) reported endothelial-dependent dilation. Catechins are converted by an enzymatic (polyphenol oxidase and peroxidase) oxidative polymerization reaction to tannins: the aflavins (benztropine ring) and arubigins, both of which are orange-red colored polyphenolic pigments that are also potent vasodilators (Yang et al. 2011:397136).

The risks of hypertension are significantly reduced by green tea by attenuating oxidative stress through a few mechanisms such as inhibition of eNOS uncoupling (Faria et al. 2012:1838); increase of CAT antioxidant enzymes while simultaneously blocking AT1 receptors in streptozotocin-treated rats (Thomson et al. 2012: 409047); upregulate the expression of antioxidant genes such as SOD1 and GST in C57BL/6 mice (Newsome, Petriello, Han, Murphy, Eske, and Sunkara 2014:126); scavenging superoxides in vitro (Nakagawa and Yokozawa, 2002:1745), and attenuate NAPDH oxidase production in people with diabetes (Ribaldo, Souza, Biswas, Block, Lopes de Faria, and Lopes de Faria 2009:96).

The bioactive tea components have been reported to express anti-inflammatory properties, reflected by the mitigated expression and release of different cytokines (Bogdanski et al. 2012:421). Green tea extract (379 mg/day for three months) also caused a decrease in BP as well as TNF-α levels (Bogdanski et al., 2012:421). In addition, EGCG was able to inhibit NFκB activation in human endothelial cells (Hong, Kim, Chang, Kim, Shin, and Ahn 2007:1957) and elicited a concentration-dependent inhibition of proliferation in human aortic VSMCs by increasing HO-1 enzyme expression (Liu, Liu, Kuo, Chong, and Hsieh 2014: 523684), while the aflavin derived from green tea have been reported to reduce VCAM-1 levels (Lü, Hua, Yu, Jiang, and Leng 2005:304).

2.4.2.6 Hibiscus sabdariffa (Roselle)

One of the most extensively studied plants for hypertension is Hibiscus, widely known as Roselle (Islam 2019:1003**)**. Roselle is a popular beverage in Africa, Europe, the Caribbean, Central, and South America. Fresh or dried, the different parts of the plant are used for food, health purposes, lotions, and refreshing beverages (Al Disi et al., 2016: 326; Islam 2019:1003). Roselle is consumed as a tea or a refreshing beverage. The blood pressure-lowering activities of Roselle have been extensively studied and reported both in humans (Onyenekwe, Ajani, Ameh, and Gamaniel 1999:199; Herrera-Arellano, Flores-Romero, Chávez-Soto, and Tortoriello 2004:375; Mojiminiyi, Dikko, Muhammad, Ojobor, Ajagbonna, and Okolo 2007:292; Mozaffari-Khosravi, Jalali-Khanabadi, Afkhami-Ardekani, Fatehi, and Noori-Shadkam 2009:48; Inuwa, Al-Lawati, Beegam, Ziada, and Blunden 2012:563; Hopkins, Lamm, Funk, and Ritenbaugh 2013:84; Islam 2019:1003) and in animal studies (Odigie, Ettarh, and Adigun 2003:181; Ali, Al Wabel, and Blunden 2005:369; Ajay, Chai, Mustafa, Gilani, and Mustafa 2007:388; Mojiminiyi et al. 2007:292; McKay, Chen, Saltzman, and Blumberg 2010:298; Ojeda, Jiménez-Ferrer, Zamilpa, Herrera-Arellano, Tortoriello, and Alvarez 2010:7; Inuwa et al. 2012:563; Hopkins et al. 2013:84; Islam 2019:1003). Additionally, all clinical trials with Roselle extracts reviewed showed a significant reduction in high blood pressure in patients who consumed varying concentrations of Roselle (Herrera-Arellano et al. 2004:375; Herrera-Arellano, Miranda-Sanchez, Avila-Castro, Herrera-Alvarez, Jimenez-Ferrer, and Zamilpa 2007:6; McKay et al. 2010:298; Jalalyazdi, Ramezani, Izadi-Moud, Madani-Sani, Shahlaei, and Ghiasi 2019:107).

Consequently, different mechanisms for Roselle's antihypertensive effect have been reported (Islam 2019:1003). The vasorelaxant pathways of both VSMCs (Ali et al. 2005:369; Ajay, Chai, Mustafa, Gilani, Mustafa 2007:388) and endothelial cells (Ajay et al. 2007:388; Herrera-Arellano et al. 2007:6) are primed by Roselle. Inhibition of Ca^{2+} channels (Ajay et al. 2007:388), the opening of KATP channels (Sarr, Ngom, Kane, Wele, Diop, and Sarr 2009:45), and increased production of NO (Ajay et al. 2007:388; Alarcón-Alonso, Zamilpa, Aguilar, Herrera-Ruiz, Tortoriello, and Jimenez-Ferrer 2012:751) are various mediated pathways of Roselle's relaxant effect. Roselle has also been reported to decrease heart rates in rats (Odigie et al., 2003:181) and inhibit cardiac hypertrophy (Odigie et al. 2003:181; Inuwa et al. 2012:563). Additionally, Roselle's diuretic abilities (Onyenekwe et al. 1999:199; Ali et al. 2005:369; Herrera-Arellano et al. 2007:6; Alarcón-Alonso et al., 2012:751; Jalalyazdi et al., 2019:107), its ability to lower uric acid concentration (Ali et al., 2005:365), and decrease in the blood sodium content of stage 1 and 2 hypertensive humans (Herrera-Arellano et al. 2007:6) have all been described. This diuretic activity is related to the vasorelaxant effect, as NO elevation is positively correlated with increases in renal filtration rates (Alarcón-Alonso et al. 2012:751).

Furthermore, potent antioxidant function (Ali et al. 2005:369; McKay et al. 2010:298), reduction of oxidative stress; potential scavenging of free radicals in the livers of CCl_4-treated rats (Ajiboye, Salawu, Yakubu, Oladiji, Akanji, and Okogun 2011:109), and enhancement of the concentration of cellular antioxidants in healthy humans (Frank, Netzel, Kammerer, Carle, Kler, and Kriesl 2012:2207) have all been reported as Roselle's activities. Lin, Chen, and Wang (2011:1245) also reported Roselle's anti-atherogenic properties as well as its ability to proliferate in VSMCs. Inhibition of Roselle's ACE activity was confirmed as part of its anti-inflammatory properties (Herrera-Arellano et al. 2007:6; Ojeda et al. 2010:7; Jalalyazdi et al. 2019:107).

2.4.2.7 Crataegus spp. (Hawthorns or thorn apple)

Asher, Viera, Weaver, Dominik, Caughey, and Hinderliter (2012:26) disclosed hawthorns' use in managing cardiovascular disorders since the seventeenth century. The plant has been described as shrubs comprised of over 300 species (Tassell, Kingston, Gilroy, Lehane, and Furey 2010:32; Csupor, Viczián, Lantos, Kiss, Hegyi, Tenk, and Tóth 2019:152984), which are widely used in most parts of the world. Walker, Marakis, Morris, and Robinson (2002:48) and Tassell et al. (2010:32), at different times, demonstrated that hawthorns produced a modest reduction in blood pressure in humans. Other clinical trials and human studies with Hawthorn extracts showed a marked reduction in blood pressure among hypertensive patients treated with Hawthorn (Asgary, Naderi G, Sadeghi, Kelishadi, and Amiri 2004:221; Bone and Mills, 2013:667). The antihypertensive actions of hawthorns are attributed to several compounds in the plant. Compounds such as epicatechin, procyanidin B-2, oligomeric proanthocyanidins (OPCs,), flavonoids (hyperoside, quercetin, rutin, and vitexin), and quercetin (a major polyphenolic flavonoid in hawthorn shrubs), have been reported (Valli and Giardina 2002:1083; Houston 2005:396; Asher et al. 2012:26; Yang and Liu 2012:1578). Quercetin has been reported (Larson, Symons, and Jalili 2012:39; Csupor et al., 2019:152984) to produce several bioactive functions including antioxidant, anti-inflammatory, and vasorelaxant effects, demonstrating a reduction in blood pressure properties (Larson et al., 2012:39). An effect on both endothelial cells and VSMCs has been reported with Hawthorn extracts, possibly due to enhanced phosphorylation of eNOS at serine 1177 and hence, NO release (Brixius, Willms, Napp, Tossios, Ladage, and Bloch 2006:177; Anselm, Socorro, Dal-Ros, Schott, Bronner, and Schini-Kerth 2009:253).

Reducing the thickness of the vascular medial layer, decreasing body weight, improving kidney function, improving hyperlipidemia, and resolving hyperplasia are all mechanistic actions reported on hawthorn that contribute to the improvement of hypertensive outcome (Koçyildiz, Birman, Olgaç, Akgün-Dar, Melikoğlu, and Meriçli 2006:66; Csupor et al. 2019:152984). These effects of Hawthorn appear to be mediated by expression of NOS enzyme, efflux of water and sodium, as well as an increase in diuretic activity. The capacity to augment the concentration of the reducing glutathione, scavenge ROS, and upregulate antioxidant enzymes (SOD, CAT) has been reported by Tassell et al. (2010:32) and Cheng, Wang, Gao, Yuan, Feng, and Cao (2013:709) as part of the integrated cardiovascular beneficial bioprocesses of hawthorn. Additionally, the decline in the concentrations of iNOS, IL-6, NF-κB, TNF-α (Topal, Koç, Karaca, Altuğ, Ergin, and Demirci 2013:330), and VCAM-1 (Shin, Lee, Lim, Ha, Seo, and Kim 2012:e45734) are mirrored as express anti-inflammatory activity with extracts of hawthorn.

2.4.2.8 Cymbopogon citratus (Lemongrass)

Lemongrass has been reported to exhibit antihypertensive properties attributed to its active phytochemicals, especially citral (Devi, Sim, and Ismail 2011:143; Unuigbe, Enahoro, Erharuyi, and Okeri 2019:1; Devi, Sim, and Ismail 2012:539475). Lemongrass has been used as an indigenous therapy in Asia, Brazil, China, and other parts of the world (Devi et al. 2012:539475; Unuigbe et al., 2019:1). Even though presently no clinical trials have been reported on lemongrass's antihypertensive effects, its relaxant properties and effects in rats have been described (Devi et al. 2011:143, 2012:539475; Bastos et al., 2010:331). Devi et al. (2012: 539475) described a dose-dependent vasorelaxation in phenylephrine pre-constricted aortic rings from male WKRs or SHRs when treated with crude extracts (leaves, stems, or roots) of lemongrass (citral). Based on their findings, activation of NO and the inhibition of calcium channels were identified and described as the underlying mechanism for this relaxation (Devi et al. 2012:539475). Similarly, an acyclic mono-terpenoid isolated from lemongrass (citronellol) produced a hypotensive response when administered in an intravenous bolus. Before the findings of Devi et al. (2012:539475), Bastos, Moreira, Ribeiro, Medeiros, Antoniolli, and De Sousa (2010:331) reported that hexamethonium, L-NAME, atropine, and indomethacin did not affect the hypotensive effect produced by *citronella*.

Besides, citronella induced relaxation of rat superior mesenteric artery via an endothelium-independent mechanism; inhibited Ca^{2+}-influx through voltage-operated calcium channels (VOCCs) as well as regulating IP3- and caffeine-gated intracellular Ca^{2+} stores (Bastos et al. 2010:331). Moderate antioxidant activity has been reported with lemongrass by some authors. For instance, Rahim, Taha, Mubark, Aziz, Simon, and Mazlan (2013:329) reported a reduction of oxidative stress and increased GSH expression in rat testes; increase in antioxidant enzymes and molecules such as SOD and GSH in murine lungs after administering 5 and 10μg of lemongrass' extract (Tiwari et al. 2010:2913) and suppress ROS molecular activity (Tiwari, Dwivedi, and Kakkar 2010:2913; Koh, Mokhtar, and Iqbal 2012:81). In addition, citral contributes to the anti-inflammatory pathways by inhibiting iNOS activity and NF-κB (Lee, Jeong, Kim, Noh, Yuk, and Hong 2008:342; Figueirinha, Cruz, Francisco, Lopes, and Batista 2010:681; Francisco, Costa, Figueirinha, Marques, Pereira, and Miguel-Neves 2013:126; Unuigbe et al. 2019:1).

2.4.2.9 Andrographis paniculata (King of Bitter)

Antioxidant effects, anti-bacterial properties, anti-inflammatory and remedies for cold, fever, and cardiovascular diseases have been reported with *Andrographis paniculata* (Awang, Abdullah, Hadi, and Fong 2012: 876458; Kunwar, Shrestha, and Bussmann 2010:35; Nyeem, Mannan, Nuruzzaman, Kamrujjaman, and Das. 2017:318). Although no clinical trial has been conducted to test the antihypertensive properties of Andrographis paniculata, some hypotensive compounds have been identified from the plant. The active hypotensive ingredients identified from the plant are andrographolide, 14-deoxy11, 12-didehydroandrographolide, and 14-deoxyandrographolide (Awang et al. 2012:876458). A decrease in blood pressure in spontaneously hypertensive rats has been shown by *A. paniculata* extracts, where angiotensin-converting enzymes and reactive oxygen superoxides have been decreased (Zhang and Tan 1996:1). Additionally, in isolated rat hearts, both 14-deoxy-11,12-didehydroandrographolide and 14 deoxyandrographolide reduced vascular resistance reflected by decreased coronary perfusion pressure (Awang et al. 2012:876458; Nyeem et al. 2017:318). A dramatic hypotensive effect was also reported with crude extracts with a high content of 14-deoxy-11,12-didehydroandrographolide (Awang et al. 2012:876458). Increased release of nitric oxide, on the other hand, was attributed to the induced vasodilation seen (Awang et al. 2012:876458). Awang et al. (2012:876458) further reported that additional inhibition of intracellular Ca^{2+} via receptor- and voltage-gated Ca^{2+} channels with 14-deoxy-11, 12 didehydroandrographolide. *A. paniculata* can potently inhibit the activation of NFκB, and daily administration of andrographolide 4mg/kg caused a significant reduction in the production of NF-κB (Das, Periyasamy, and Pandey 2012:430). Furthermore, reports also indicated *A. paniculata* exhibits antiinflammatory activities in natriuretic peptide receptor-A (Npr1) gene knockout mice (Das et al. 2012:430; Nyeem et al. 2017:318).

2.4.2.10 Apium graveolens (Celery)

Moghadam, Imenshahidi, and Mohajeri (2013:558) reported the hypotensive effects of seed extracts of celery reducing blood pressure in deoxycorticosterone acetate-induced hypertensive rats after the administration of 300mg/kg aqueous ethanolic (20/80, v/v), hexanic and methanolic extracts of Apium graveolens. Compared to other solvents, extracts of Apium graveolens, the hexanic extracts are more potent in lowering blood pressure. N-butylphthalide gives celery its aromatic odor and flavor and has been reported to lower blood pressure in animal models (Tsi and Tan 1997:576; Dianat, Veisi, Ahangarpour, and Moghaddam 2015:203; Tashakori-Sabzevar, Razavi, Imenshahidi, Daneshmandi, Fatehi, Sarkarizi, and Mohajeri, 2016:619). Aortic ring contractions caused by cumulative calcium increases in high potassium (60mM); thus, blocking of Ca^{2+} influx via calcium channels, has also been shown to be a property of apigenin flavone isolate of A. *graveolens* (Ko et al., 1991:69). Notably, extracts and celery constituents have been reported to reduce arterial pressure in humans (Weber et al. 2014:3; Al Disi et al. 2016:5; Dianat et al. 2015:203; Tashakori-Sabzevar et al. 2016:619), possibly by lowering levels of circulating catecholamines and decreasing vascular resistance (Houston 2005:396). Conversely, this herb can reduce oxidative stress by its flavonoid content that potentiates antioxidant mechanisms (Popovic, Kaurinovic, Trivic, Mimica-Dukic, and Bursac 2006:531; Dianat et al. 2015:203; Tashakori-Sabzevar et al. 2016:619).

2.4.2.11 Coptis chinensis (Chinese Goldthread)

The ability of Chinese goldthread’s main compound Berberine (BBR) to lower blood pressure has been indicated since *Coptis chinensis* has been used widely in Chinese traditional medicine (Affuso, Mercurio, Fazio, and Fazio 2010:71; Xiong, Yang, Liu, Zhang, Wang, and Wang 2013b:275279; Liu and Huang 2016:469). Significant hypotensive effects have been reported in clinical trials and meta-analyses (Lan, Zhao, Dong, Yan, Zheng, and Fan 2015:68). The increased antioxidant enzyme, SOD in rats with an atherosclerotic renovascular disease, amelioration of oxidative stress (Zhang, Song, Liu, Li, Zhao, and Zhang 2011:450; Wan, Chen, Liu, Zhao, Huang, and Zhang 2013:e59794), scavenging ROS, via inhibition of NADPH oxidase (Wan et al.

2013:e59794), and relaxing arterial tissues through endothelial-dependent and independent routes (Affuso et al. 2010:71) have all been proposed as goldthread's antihypertensive effects. A concomitant increase in NO release that leads to enhanced flow-mediated vasodilation due to elevation in the expression of eNOS by BBR has also been indicated (Affuso et al. 2010:71; Zhang et al. 2011:450; Liu and Huang 2016:469). The opening of KATP channels, blockage of Ca^{2+} influx, and the vasodilator PGI2 are the likely reported mediated vasodilation effects caused by BBR (Zhang et al., 2011:450). Additionally, VSMC proliferation modulates inflammatory pathways through suppression of transcription factor NF-κB, VCAM-1 expression (Affuso et al. 2010:71; Wan et al. 2013:e59794; Liu and Huang 2016:469), and inhibiting endothelial injury (Wang, Huang, Lam, Li, Wong, and Ye 2009:484) have been described with an isolate of BBR. BBR also improves cardiac muscle hypertrophy and lipid profile by reducing total and LDL cholesterol (Zhang et al., 2011:450; Liu and Huang 2016:469).

2.4.2.12 Panax (Ginseng)

The principal active components of ginseng are heterogeneous triterpenoid saponins and steroid glycosides or ginsenosides (or panaxosides). In contrast, the four most common species of ginseng are *P. notoginseng* (Chinese ginseng, *P. ginseng* (Asian or Korean ginseng), *P. japonicas* (Japanese ginseng), and *P. quinquefolius* (American ginseng) (Valli and Giardina 2002:1083; Kim 2012:16; Liu and Huang 2016:469; Komishon et al. 2016:619). Ginseng is prepared and administered in various forms, either as a solid (tablets, capsules, dried roots), or as a liquid (oil, extracts, or tea) (Valli and Giardina, 2002:1083), and used for centuries as folk medicine in Asia (Jang et al. 2011:176; Kim 2012:16; Komishon, Shishtar, Ha, Sievenpiper, de Souza, Jovanovski, Ho, Duvnjak, and Vuksan 2016:619).

Several authors have reported both the antihypertensive effect of ginseng and its ability to elevate blood pressure (Jeon, Kim, Park, Lee, Park, and Kim 2000:135; Valli and Giardina, 2002:1083; Jang, Lim, and Lim 2011:176; Kim, 2012:16; Mucalo, Jovanovski, Rahelic, Božikov, Romic, and Vuksan 2013:148; Liu and Huang 2016:469). Higher ginseng concentrations showed hypotensive effects, while low doses were contextually shown to raise blood pressure (Jang et al. 2011:176). Varied action of different ginsenosides could be a probable explanation for this phenomenon (Valli and Giardina, 2002:1083). Although the primary mechanism associated with the ginseng-induced hypotensive effect is attributed to an improved arterial function, regulating the arterial baroreflex, tuning vascular function, or modulating the autonomic nervous system are possible suggestions on the ginsengs blood pressure mechanism (Kim 2012:16).

Ultimately, activation of eNOS (Valli and Giardina 2002:1083; Jang et al. 2011:176; Liu and Huang 2016:469; Komishon et al. 2016:619), a dramatic increase in eNOS expression and NO production (Valli and Giardina 2002:1083; Jang et al. 2011:176, 2012:463; Hong, Kim, Ahn, Shin, and Kwon 2012:3086; Pan et al., 2012:106), increase NO and cGMP levels, as well as activation of Ca^{2+}-gated potassium channels (Kim, Kang, Park, and Schini-Kerth 1999b:41), have all been documented with ginseng. Ginseng also elicits an anti-proliferative eﬀect on VSMCs. Hence, it can be expected to possess antihypertensive and anti-atherosclerotic capacities (Jovanovski, Bateman, Bhardwaj, Fairgrieve, Mucalo, and Jenkins 2014:537). In addition to antihypertensive eﬀects, Choi, Kim, Choi, and Lee (2013: e59978) documented ginseng's role as anti-carcinogenic and antidiabetic effects.

2.5 INTERACTIONS BETWEEN INDIGENOUS AND WESTERN THERAPIES

With wide acceptance and use of herbal remedies in different cultures, there is a growing habit of concurrent herb-drug use, which raises the concern for pharmacokinetic interactions (Parvez and Rishi, 2019:275). In many communities, administering herbal remedies in combination with therapeutic drugs is a common practice, raising the potential for herb-drug interactions. Furthermore, the rising interest in natural products for disease management has reawakened natural product research in drug discovery, necessitating pharmacokinetic studies of phytochemicals, including their potential for drug interactions. Therapies involving these agents have shown promising potential with significant efficacy. However, many of these indigenous products are yet to be scientifically tested, and a large portion of them are either not monitored or poorly monitored scientifically. The result of a lack of adequate knowledge of indigenous products, especially their pharmacokinetic and pharmacodynamics with existing Western medications and other food products, calls for caution and a more rational approach in their usage (Ekor 2014:177). Accordingly, the availability of Western medicines in the market follows rigorous laboratory and clinical investigations and goes through stringent regulatory scrutiny; the same cannot be said of indigenous therapies. A wide variety of acclaimed herbal products currently lack sufficient scientific data to provide information on such products' safety or efficacy (Parvez and Rishi, 2019:275). The concomitant use of Western medications and indigenous therapies could result in drug-herb interactions that could result in clinical outcomes that are unwanted or toxic. To make matters worse, most individuals consuming both western and indigenous therapies do not provide vital documentation of such usage, thereby making clinical decisions on interactions difficult (Parvez and Rishi, 2019:275).

In any case, not many studies have been reported on the dynamics that occur during a concomitant administration of a medicinal herbal product and conventional Western drugs. In terms of pharmacokinetics and pharmacodynamics influence, studies into indigenous herbal products' influence on drug pharmacokinetics are necessary, as noted by Fasinu, Bouic, and Rosenkranz (2012). Fasinu et al. (2012) reported further that the non-specificity of metabolic enzymes and drug transporters makes them susceptible to interactions with phytochemicals, where the latter can be substrates, inhibitors, or inducers. The inhibition and induction of metabolic enzymes or transport proteins are not desirable, especially in the events of concomitant herb-drug consumption or multiple uses of medicinal products. Such effects as the failure attributed to induced metabolism by St. John's wort (SJW) have been widely reported. Previous reports implicated SJW in numerous herb-drug interactions that may have clinical importance (Fugh-Berman, 2000; Fasinu et al., 2012; Borse, Singh, and Nivsarkar, 2019). For instance, breakthrough menstrual bleeding has been reported in women taking oral contraceptives in combination with SJW. The common herbal products that interact with western medications have been reported to include *Panax ginseng* (ginseng), *Ginkgo biloba* (ginkgo), *Hypericum* *perforatum* (St John's wort), *Allium sativum* (garlic), and *Zingiber officinale* (ginger). Furthermore, St. John's wort has been reported to significantly reduce the blood concentrations of Theochron (theophylline), Gengraf (cyclosporine), Prograf (tacrolimus), Lanoxin (digoxin), Crixivan (indinavir), Versed (midazolam), Elavil (amitriptyline), Coumadin (warfarin) and Marcoumar (phenprocoumon). St. John's wort also reduced the area under the plasma concentration-time curve (AUC). Common drugs that interact with herbal medicines include Crixivan (indinavir), Coumadin (warfarin), Gengraf (cyclosporine), Prograf (tacrolimus), Lanoxin (digoxin), Elavil (amitriptyline), Versed (midazolam), and Camptosar (irinotecan). Indigenous herbal therapies may interact with drugs in the kidneys, intestines, liver, and at the receptor site of action on the target organ. Most of these Western medications have been reported to have significant, narrow therapeutic indices; as such, they may be prone to toxic adverse reactions (Parvez and Rishi 2019:275).

Despite the multi-beneficial effects of consuming herbs in managing and treating several diseases, including hypertension, herbal medicine is not without many limitations. The World Health Organization presented the under-listed limitations of using complementary and alternative therapies (WHO, 2019).

a. *Lack of sufficient quality control due to the absence of governmental or other health-related bodies overseeing the production and other relevant issues on herbal medicine, practice, and products.*

b. *Undesired side effects, which may not always be very obvious or immediate.*

c. *Allergy to some components of the herb (or herbal product).*

d. *Seasonal variations in the herbal plant parts (both aerial: bark, leaves, flowers, fruit seeds or stems, and underground: rhizomes or roots) and the potential quantitative changes in composition and ratios of bioactive ingredients.*

e. *Drug interactions with other medicines.*

f. *Adulteration of medications, where herbal prescriptions can be mixed with synthetic drugs like pain-killers or anti-inflammatory corticosteroids.*

g. *The long time needed for an effect to be observed in some cases, which consequently precludes the use of the herb/herbal compound when an immediate resolution to the medical problem is needed.*

h. *Limitations in certain diseases, since herbal medicine cannot heal a concussion, broken bone, or a heart attack.*

i. *Misclassification of the herb/plant, which may sometimes lead to misidentification.*

j. *The lack of enough information on labels of bottles of herbal products, such as expiry dates (and how this affects the function; related to point "a" above).*

k. *The lack of awareness among patients, physicians, and the average public about the use or abuse of herbs and herb-related products.*

l. *Self-medication due to over-the-counter availability of many herbal products.*

m. *The large numbers of similar herbs in respective pharmacopeias.*

2.6 SUMMARY OF THE CHAPTER

This chapter presented an extensive review of the literature on indigenous-western antihypertensive therapies. A review of the literature on the pathophysiology of hypertension and the factors that contribute to hypertension development was presented. The chapter also reviewed all the medications used in managing hypertension and interactions that are likely to occur when such medications are used concurrently with indigenous therapies. The use of plants and herbs in the management of hypertension was also extensively reviewed. Western medications that were discovered from medicinal plants and different plants and herbs that have been tested for the management of hypertension are presented. The following chapter will present the research design and methodologies used for data collection and analysis.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.0 INTRODUCTION

The previous chapter focused on the literature review for both indigenous and western therapies. This chapter describes the research design and methodologies involved in indigenous-western therapies used in managing hypertension in Belize. Creswell (2015:535) described research design as a broad framework that provided guidelines, in this case, on indigenous-western therapies used in the management of hypertension in Belize. Both quantitative and qualitative research designs were used in this study, as this chapter explained the need for such integration. The chapter also presented sample and sampling techniques used for data collection. The data analysis methods were also presented and related to the collected data's reliability, validity, and trustworthiness.

3.1 RESEARCH DESIGN

Yousaf (2019:1) described the research design as the systemic approach used to conduct scientific research and its overall organization of all identified constituents and data that resulted in credible outcomes. A strategic methodology is employed to provide plausible, accurate, and authentic outcomes in line with the type of research chosen. This study on indigenous-western antihypertensive therapies in Belize utilized the mixed-methods explanatory sequential design via which data were collected using quantitative and qualitative techniques. Creswell and Creswell (2018:35) described mixed methods research design as a procedure for collecting, analyzing, and "mixing" quantitative and qualitative methods in a single study or a series of studies to understand a research problem. Data collected in this study, therefore, utilized both quantitative (Phase I) and qualitative (Phase II) research designs. The study's 2 phases were integrated to provide a comprehensive understanding of indigenous-western antihypertensive therapy practices among hypertensive patients in Belize.

The research was designed to collect quantitative data, followed by qualitative data, and integrate the two after that.

3.2 QUANTITATIVE RESEARCH DESIGN

A quantitative research design examines relationships among variables as a means of testing theories (Creswell and Creswell, 2018:37). A quantitative research design is considered a rational process for verifying, refuting, or lending credibility to theories that have existed (Leavy 2017:300). The research design involves identifying correlations and patterns in variable relationships by examining and testing such variables. In this phase of the study, the primary purpose was to assess the utilization of indigenous-western antihypertensive among Belizeans diagnosed with hypertension; therefore, acquiring knowledge, neutrality, and objectivity shall characterize the study results.

3.3 QUALITATIVE RESEARCH DESIGN

Quantitative research has been defined as a technique for examining and better-comprehending individuals or groups attributed to a social or peculiar problem (Creswell and Creswell, 2018:37). With qualitative research, data is typically obtained from the participant's setting using questions and procedures that will generally lead to an inductive analysis from thematic interpretations. A full depth of comprehension of the phenomenon being investigated is presented at the end of the qualitative study. In the current study, the qualitative research designed was utilized to explore and understand the practices of indigenous-western antihypertensive therapies in Belize. The qualitative component of gathering data provided a focused engagement with indigenous therapy users and indigenous therapy vendors to help unravel the practices of indigenous therapies in managing hypertension in Belize. The participants' experiences in utilizing indigenous antihypertensive therapies were captured, which helps to explain the phenomenon.

3.4 MIXED-METHODS

In mixed methods research, the analyzed quantitative and qualitative data are integrated into a single dataset to understand the studied phenomenon (Leavy 2017:300). In this study on indigenous-western antihypertensive therapies, both data collected during the quantitative and qualitative phases were integrated to provide a depth of comprehension. Mixed-methods sequential explanatory design implies collecting and analyzing quantitative and then qualitative data in two consecutive phases within one study (Creswell and Creswell, 2018:37). Using the sequential explanatory design only requires the research investigator to generalize some specific aspects of investigations (Ary, Jacobs, Sorensen, and Walker 2014:56). Furthermore, with an explanatory sequential study design, the researcher collects data during the quantitative (numeric) study and analyzes it as a first step to the mixed methods. To help explain or elaborate on the quantitative results obtained in the first stage of the study, the researcher further collects and analyzes more data in the qualitative phase, which builds on the first stage of the research. Second, the qualitative stage expands on the prior quantitative understanding of the phenomenon investigated. This approach reasons that the quantitative information and subsequent results give a general comprehension of the studied phenomenon. The qualitative data and their analysis refined and explained the statistical results by exploring participants' views in more depth (Creswell 2015:535; Alvarez and Woodhead-Lyons 2013:697).

Consequently, scholars argued that explanatory research aimed at exploring the research questions to provide a definitive and final solution to the problems which are already existing (Wisdom, Cavaleri, Onwuegbuzie, and Green 2012:721). Therefore, explanatory sequential study designs are conducted to determine the nature of the problem while offering conclusive evidence and understanding the nature of the problem better.

It is always maintained that when the researcher is conducting an explanatory sequential study design, he or she must be flexible enough to change the direction of the study due to new insights and data revelation (Bazeley and Jackson 2013:170). However, in some cases, explanatory research always intends to handle new problems in which minimal studies have been done previously. Moreover, it is essential to appreciate that an explanatory sequential study is usually the initial research of its kind, which forms a more conclusive study (Saunders, Lewis, and Thornhill 2009). Other studies have shown that explanatory research can provide new research design, data collection methods, and sampling techniques (Creswell and Plano-Clark 2018:54).

Therefore, with this background, the main advantage of why explanatory sequential study design was opted for in examining the indigenous-western antihypertensive therapies in Belize was that such a study had not been conducted before in Belize. Hence, the study design enabled the researcher to explore all the relevant data that was needful for the study, improving the study's general reliability and validity (Bazeley and Jackson 2013:170). The design also provided the researcher with a chance to know how cultural influence affects the usability of indigenous-western anti-hypertensive therapies among hypertensive patients in Belize. Bowling (2014:215) pointed out that explanatory study design is a descriptive study that involves describing a given population in the society, their behavior, or the process of undertaking such types of research.

Accordingly, in this study, explanatory sequential research methodology, therefore, played a very prominent part in the development of the process and the procedures that are to be followed in order to attain the results that have been desired in examining indigenous-western therapies in the management of hypertension in Belize (Alvarez and Woodhead-Lyons 2013:697).

Thus, the explanatory sequential research methodology is marked as highly evident norms that must be designed to improvise or produce the result to ensure that the study has successfully come up with the exact outputs to be achieved during the investigation. Therefore, this section describes the general design applied when collecting data and how the data was analyzed. Furthermore, the section also incorporated the sampling technique applied, data collection procedure, data analysis technique, reliability, validity, and trustworthiness. Lastly, the general ethical considerations were also presented in this chapter. Overall, the entire section will provide the exact procedures to be followed by this current study to derive the results.

Finally, because a mixed-methods explanatory sequential study design was used for this study, it implied that both quantitative and qualitative data collection methods were employed. The mixed-methods sequential explanatory design consists of two distinct phases: quantitative and qualitative (Creswell and Creswell, 2018:37). First, quantitative data were collected, analyzed, and the results set up the second qualitative phase stage. The qualitative data were collected and analyzed second in the sequence, help explained, or elaborated on, the quantitative results obtained in the first phase, and the two phases are integrated with the intermediate stage in the study. This approach's rationale is that the quantitative data and subsequent analysis provided a general understanding of the research problem. The qualitative data and their analysis refined and explained the statistical results by exploring participants' views in more depth (Creswell and Creswell, 2018:37). The author further described the advantages of this approach to include straightforwardness and opportunities to explore the quantitative results in more detail. This design can be advantageous when unexpected results arise from a quantitative study. The current study on indigenous-western antihypertensive therapies was divided into two phases based on the data collected.

3.5 PHASE I: RESEARCH METHOD

A cross-sectional quantitative survey was conducted among hypertensive patients in Belize. Research participants included adult hypertensive patients residing in the country of Belize. The quantitative research designed ensured data on indigenous-western therapies to be collected utilizing a well-structured questionnaire containing 38 items. Some of the questions were adapted and modified to use in this study. This study employed a mixed-methods explanatory sequential design under which data were collected using quantitative and qualitative techniques. Creswell (2015:535) described mixed methods research design as a procedure for collecting, analyzing, and "mixing" quantitative and qualitative methods in a single study or a series of studies to understand a research problem.

3.5.1 Phase I: Sampling

Sampling is a process utilized in statistical analysis during which a predetermined number of observations are taken from a more significant population. A sample is usually taken from a larger population using a sampling technique (Creswell 2015:20).

3.5.1.1 Study Setting and population

The cultural, physical, social, and environmental sites for which research is conducted is considered the research setting (Creswell 2015:20). The current study on the use of indigenous-western antihypertensive therapies was conducted in the entire country of Belize. Belize (formerly British Honduras) is the only commonwealth and English-speaking country in Central America, and by its geographical location and historical background, it is part of both Central America and the Caribbean (Figure 3.1). Therefore, the country participates in the programs of the Central American Integration System (SICA) and the Caribbean Community (CARICOM). It has a total area of about 8, 867 square miles (23,000 km^2) and shares borders with Guatemala (266 km) to the south and west and Mexico (250 km) to the north. It is bordered by the Caribbean Sea to the east, with 386 km of coastline (Figure 3.1).

According to the 2010 last census report, the country had 351,600 (Statistical Institute of Belize [SIB] 2013:1). The current 2019 population was estimated at 408,487 (SIB 2019:1). The main ethnic groups in the country are Mestizo, Creole, Maya, and Garifuna. The literacy rate is 79.7%, with an unemployment rate of 14.2%. Belize is a parliamentary democracy, a member of the Commonwealth, divided into six administrative districts (Fig. 3.1). The country has a GDP of USD 1.987 billion, a GDP growth rate of 0.7%, and an inflation rate of 0.3% (2018). Belize's total exports for 2018 were estimated at US$200 million annually. The economy's principal sectors are agriculture, agro-processing, and service, primarily tourism (Martin and Manzano 2010:107; Leslie and Heusner 2002:5). The main exports were sugar and molasses (30%), bananas (18.5%), citrus (15.7%), marine products (10.7%), and crude petroleum (6.3%) (SIB 2019:1).

Figure 3.1 Map of Belize, Central America

Source: google maps

3.5.1.2 Phase I: Methodology

A cross-sectional quantitative survey was conducted among hypertensive patients in Belize, where data was collected using a well-structured questionnaire, as described below.

3.5.1.3 Phase I: Population

A population is a group of individuals who have the same characteristic, while a sample is a subgroup of the target population that the researcher plans to study for generalizing about the target population (Creswell 2015:142). The participants in this study comprised all hypertensive adult patients currently accessing antihypertensive medications from any government-owned hospitals, private clinics, or pharmacies in the entire country of Belize. The participants' eligibility in this phase of the research comprised all hypertensive adult patients currently attending government hospitals, private clinics, or community pharmacies. All hypertensive adult patients currently accessing antihypertensive medications at any government-owned hospitals, private clinics, or pharmacies were eligible and participated in the research. Participants who were duly diagnosed with hypertension volunteered to participate in the research after giving their consent to partake in the survey. Participants who did not give consent to participate in the study were excluded from the study.

3.5.1.4 Phase I: Sampling

Leavy (2017:76) defined sampling as the process whereby a subset of the population is selected to represent the study population and make possible statistical inferences. In this study, a non-probability convenient sampling technique was used to collect data on the use of indigenous-western antihypertensive therapies in Belize in this first phase of the research. The purpose of the convenient sampling technique was to identify patients diagnosed with hypertension specifically. Patients refilling antihypertensive medications at government-owned or private hospitals inclusive of pharmaceutical shops were identified and asked to participate in the study. Therefore, with a convenient sampling technique, participants in a given unit are chosen based on a specific purpose. It has been considered as a useful sampling method that involves receiving relevant information from a sample population that the researcher believes is aware of the phenomenon investigated (Leavy 2017:76).

3.5.1.5 Phase I: Sample

The sample size was used to draw and generate data from the number of individual cases in the study population (Leavy 2017:76). This study employed a convenient sampling technique to obtain data from diagnosed hypertensive patients in Belize. A sample size of 422 was used for the study with a 95% confidence level and a +/- 5% confidence interval to determine sample size. The sample size was determined using the online software Open Epi (Epi Info™), Version 3, open-source.

3.5.1.6 Phase I: Sample size calculation

OpenEpi (Epi Info™), Version 3, open-source calculator (Dean et al. 2018:1) was used to calculate sample size (Table 3.1). OpenEpi (Epi Info™) is a free and open-source software for epidemiologic statistics. It provides statistics for counts and measurements in descriptive and analytic studies, stratified analysis with exact confidence limits, matched pair and person-time analysis, sample size and power calculations, random numbers, sensitivity, specificity and other evaluation statistics, R x C tables, and chi-square for dose-response (Dean et al. 2018:1).

Using the OpenEpi (Epi Info™) open-source sample size calculator, therefore, the country size was calculated to be 384 x 10% = 422. The addition of 10% was to take into account the non-response factor. The final sample size, therefore, arrived at 422. In order to obtain proportionate samples from the six districts in the country, the 422 total sample size was further stratified proportionately to obtain representative behaviors from each district (Table 3.1). A total of 422 questionnaires were used for data collection in this phase of the study. Stratified proportionate samples were further calculated based on the district population, as shown in Table 3.1.

Table 3. 1 Sample size calculation (OpenEpi open-source calculator).

Population size (for Finite Population Correction factor or FPC) (N):	398050
Hypothesized % frequency of outcome factor in the population (p):	50%+/-5
Confidence limits as % of 100(absolute +/- %) (d):	5%
Sample Size(n) for Various Confidence Levels	1
Confidence Level (%)	95%
Sample Size	384
Equation: Sample size n = [DEFF*Np(1-p)]/ [(d2/Z21-α/2*(N-1) + p*(1 p)]	

The phase I total sample size was calculated to be 384 x 10% = 422. The addition of 10% was made to consider the non-response bias (Suresh and Chandrashekara 2012:7). The final sample size was estimated to be 422. In order to obtain proportionate samples from the six districts in the country of Belize, the 422 total sample size was further stratified proportionately. The total sample size computed was further proportionately stratified to calculate sample sizes for each district, as shown in Table 3.2. The strategy to stratify the sample size was to provide a proportionate selection of participants from each district based on the districts' population behaviors.

Table 3.2. Districts population and sample size.

District	Population	Sample size
Belize	120, 602	128
Cayo	96,197	102
Orange Walk	51, 749	55
Corozal	48, 429	51
Stann Creek	43, 452	46
Toledo	37, 614	40

3.5.1.7 Phase I: Data collection

A questionnaire was used for data collection in this first phase of the research. Creswell (2015:9) defines data collection as a “means of identifying and selecting individuals for a study, obtaining their permission to study them, and gathering information by asking people questions or observing their behaviours.” In this phase of the study, data were collected from hypertensive patients in Belize’s entire country using a carefully designed, well-structured questionnaire. The data collection approach was first to pretest questionnaire, and then a validated questionnaire was used to gather data from patients diagnosed with hypertension.

3.5.1.8 Phase I: Development of the questionnaire

The questionnaire was first presented to the research supervisor, expert professors in questionnaire design, health practitioners, and pharmacists for review. Their recommendations led to the inclusion of questions on medication adherence to explain indigenous therapy usage. Furthermore, the item on herbal teas usage was added for respondents who may not be directly consuming indigenous therapies but are taking prepared teas to manage their hypertension. The questionnaire was then piloted in 35 hypertensive patients in Belmopan to check for errors. Some spelling and grammatical errors have been corrected. The skip option was further added to individuals who indicated that they did not use indigenous therapies to manage their hypertension.

3.5.1.9 Characteristics of the questionnaire

The questionnaire was the tool used for data collection in this phase of the study. A questionnaire is defined as a predetermined set of questions used to collect data (Bolarinwa 2015:196). For this phase, therefore, a carefully designed questionnaire was developed after reviewing relevant available literature. Some questions were adapted and modified from previously developed research instruments (TRAMIL 2010:1; Picking, Younger, Mitchell, and Delgoda 2011:305), which align with current research. The questionnaire was divided into three sections and consisted of 38 items.

The questionnaire had an introductory part in which the research focus and summary of objectives were outlined for the participants. After that, the questionnaire was divided into three sections that consisted of 38 items. The first section of the questionnaire obtained general information from the respondents. Questions addressing demographics formed the first section of the questionnaire.

The second part of the questionnaire focused on collecting information on hypertension diagnosis, medication use, and medication adherence. Simultaneously, the final set of questions explored indigenous therapies usage and concomitant indigenous-western therapies utilization among hypertensive patients in Belize. The three sections that made up the questionnaire were as follows:

Section A. Demographic data: 9 items were included in the demographic data. These are age, gender, marital status, religious affiliation, educational status, employment status, district, ethnicity, and monthly income.

Section B: Western medication usage: 10 items were included in this section. The items explored hypertension diagnosis, Western antihypertensive medication use, and adherence.

Section C: Indigenous therapy usage: In total, 19 items examined indigenous therapy usage in managing hypertension in Belize.

In this case, the study participants were selected based on pragmatic considerations such as being diagnosed with hypertension, willingness to consent to participate in the study, and their availability during the study. It is important to note that only patients suffering from primary hypertension were conveniently recruited to participate in the study. Belizean residents diagnosed with hypertension by a medical person and are currently on antihypertensive medications were included in the survey.

3.5.1.10 Phase I: Piloting and validation of the questionnaire

The questionnaire was first presented to the research supervisor for a critical review. Input from the research supervisor and other professional colleagues, health practitioners, and pharmacists was also sought for further review and feedback. Their recommendations led to the inclusion of questions on medication adherence to explain indigenous therapy usage. Furthermore, the item on herbal teas usage was added for respondents who may not be directly consuming indigenous therapies but are taking prepared teas to manage their hypertension. The questionnaire was then piloted in 35 hypertensive patients in Belmopan to check for errors. Some spelling and grammatical errors have been corrected. The skip option was further added to individuals who indicated that they did not use indigenous therapies to manage their hypertension.

The questionnaire was further validated using statistical methods. Reliability testing of the questionnaire showed a Cronbach's alpha value of 0.779. An exploratory factor analysis (EFA) using principle component analysis extraction and direct oblimin rotation with Kaiser Normalization was also employed, which extracted five components. The Kaiser Mayer Olkin (KMO) measure of sampling adequacy and Bartlett's test for sphericity was also employed, which reported a value of 0.6 and a significant *p-value* less than 0.001, respectively. Therefore, based on the statistical validation, the questionnaire was divided into three sections: demographic information, hypertension, and medication usage, and indigenous-western therapies usage. In this regard, the questionnaire was considered validated and used for data collection in the first phase.

3.5.1.11 Data collection process

Creswell (2015:9) defines data collection as a "means of identifying and selecting individuals for a study, obtaining their permission to study them, and gathering information by asking people questions or observing their behaviors." Participants were recruited from government hospitals and pharmacies, private hospitals, and pharmaceutical stores. Consent was first sought from participants before the questionnaire was administered, and the researcher assisted those who could not read or write. Participation was voluntary and without any incentive or pressure from the researcher.

Data were gathered from hypertensive patients in Belize using a structured, validated questionnaire. The study's objectives and significance were explained to the respondents, and any queries they had addressed. Their consent was then sought, and they were informed that participation was voluntary and free to withdraw from the research without any penalty or repercussions from the researcher. The questionnaires were then administered to the participants by the researcher using paper and pencils. Those who could complete the questionnaire without assistance were allowed to do so, while the researcher assisted those who could not. The self-administered questionnaires were distributed at hospitals and pharmacy outlets throughout the country. Confidentiality and anonymity were strictly applied, and participant identifiers were not required, except if the participants met the requirement for phase II (qualitative) of the study and were willing to participate. Completed questionnaires were retrieved and stored in a secure cabinet for safety. The confidentiality of respondents' information was maintained at all times. A total of 422 questionnaires were completed from October 2018 to April 2019.

3.5.1.12 Phase I: Ethical considerations related to data collection

The research proposal and instrument was duly reviewed and approved by the research supervisor. Ethical Clarence for the study was obtained from UNISA's review board (approval # HSHDC/761/2017) and Faculty of Health Sciences, Univerisity of Belize. Participants were approached, and consent was sought and obtained before the administration of the questionnaire. Participants were informed that their participation was voluntary, and at any point in the study, they were free to withdraw without any consequences. Identifiers were not used on the questionnaire, and participant's personal information was not requested as part of the study, except for those who indicated they were interested in participating in the second phase of the study. The researcher secured collected data in a locked drawer at the University of Belize.

3.5.1.13 Phase: Data analysis

Analyzing and interpreting the data involves representing it in tables, figures, and pictures to summarize it, concluding, while explaining the conclusions in words to provide answers to research questions (Creswell: 2015:10). Collected data were analyzed using descriptive and inferential statistics. Data coding was done using Statistical Package for the Social Sciences (SPSS) version 21.0 software before being analyzed. Two other reviewers' then cross-checked coded data to ensure that they are consistent, readable, and complete. Mistakes from respondents were checked or corrections made as deemed necessary (Clarke and Braun 2017:120). Descriptive statistics were primarily used to describe demographic data and research questions based on frequency, and inferential analyses were used to explore relationships. The main descriptive statistical procedures used were frequencies and percentages, and the main inferential statistics were z-score tests.

3.6 PHASE I: RIGOR OF THE STUDY

3.6.1 Validity

In its simple definition, validity is the ability of a given research instrument to measure what is supposed to be measured (Elo, Kääriäinen, Kanste, Pölkki, Utriainen, and Kyngäs 2014:1). The validity of this study was assured through the following procedures. First, the content validity of the instrument was determined by expert judgments. The peer reviews and research supervisor carefully scrutinized the instrument/items' to judge the items on their appropriateness of the content and or need modification to achieve the study's objectives. The supervisor determined whether the research instruments' items adequately represented all the areas needing investigation.

The well-designed questionnaire was then pretested to ensure coherence and comprehensiveness. The pretest was done for the questionnaires to maximize their relevancy, preciseness, and clarity in answering the required research questions. All ambiguous questions were modified, deleted, or appropriately replaced. In addition, research experts, including the research supervisor, were frequently consulted at each stage of the study for corrections and criticism of data collection tools (Gysels et al., 2013:907). This approach aimed to ensure that the study results truly represent indigenous-western anti-hypertensives usage among hypertensive patients in Belize.

Similar findings can be obtained even if the study is carried out by another researcher at different times so long as all other factors are kept constant. Finally, the questions were standardized to ensure that they provided desired answers on indigenous-western antihypertensive therapies. The researcher also ensured the data's validity by personally administering the questionnaires to all the participants.

3.6.2 Reliability

Reliability refers to the extent to which a given study is consistent and stable when the same techniques are applied in a repeated number of ways or the scores from an instrument are stable and consistent (Creswell 2015:159). The primary role of reliability in this research is to minimize biases and errors encountered in the study. The questionnaire was tested for reliability using statistical methods (Bolarinwa 2015:198). Reliability testing of the questionnaire showed a Cronbach's alpha value of 0.779. An exploratory factor analysis (EFA) using principle component analysis extraction and direct oblimin rotation with Kaiser Normalization was also employed, which extracted five components. The Kaiser Mayer Olkin (KMO) measure of sampling adequacy and Bartlett's test for sphericity was also employed, which reported a value of 0.6 and a significant *p-value* less than 0.001, respectively. Therefore, based on the statistical reliability testing, the questionnaire was deemed validated for indigenous-western antihypertensive therapy use in Belize. In this regard, the questionnaire was considered validated and used for data collection for this study phase.

3.7 PHASE II: QUALITATIVE SECTION

To understand how Belizean hypertensive patients use indigenous-western therapies to manage hypertension, this study phase used an exploratory, descriptive design with narration. This phase also explored and described how the indigenous medicines were prepared and stored by the users as antihypertensive remedies.

3.7.1 Phase II: Research design

Yousaf (2019:1) described the research design as the systemic approach used to conduct scientific research and its overall organization of all identified constituents and data that resulted in credible outcomes. A strategic methodology is employed to provide plausible, accurate, and authentic outcomes in line with the type of research chosen. In order to understand how and why Belizeans use indigenous-western therapies to manage hypertension, a qualitative design was carried out. A qualitative research method was used in this second phase of this study. Creswell (2015:16) describes qualitative research as "an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The researcher, in this case, builds a complex, holistic picture, analyzes words, reports detailed views of informants, and conducts the study in a natural setting." Qualitative research comprises checking the qualities or characteristics that are not possible to be presented in numerical value. It is a study that focuses on the phenomena that occur within natural settings and comprises studying such phenomena within complexities. Creswell (2015:204) further describes qualitative research as comprising checks on the qualities or characteristics that cannot be presented in numerical value. It is a study that focuses on the phenomena that occur within natural settings and comprises studying such phenomena within all complexities. Within the context of this study, literature has offered suggestions that systematic and structured approaches are very crucial in tackling the potential causes of undesirable performance for the national culture in animation cinemas (Sandelowski et al. 2014:347).

Therefore, the qualitative methodology was used in this study to get to know the actual perception of the population sampled for the use of indigenous-western anti-hypertensives among hypertensive patients in Belize. Similar to any other qualitative research, the study was field focused. Scholarly literature shows that qualitative studies are usually exploratory in their natures and might comprise interviews or focus groups (Wilson 2013:275).

Furthermore, as earlier indicated, this research utilized a mixed methods explanatory sequential design via which data collected using both quantitative and qualitative techniques integrated. Creswell (2015:535) described mixed methods research design as a procedure for collecting, analyzing, and “mixing” quantitative and qualitative methods in a single study or a series of studies to understand a research problem. Data collected in this segment of the study and the second segment of phase II were integrated to provide a comprehensive understanding of indigenous-western antihypertensive therapies usage among hypertensive patients in Belize. This research phase was designed to collect data using a qualitative design.

3.7.2 Phase II: Research methodology

A qualitative research method was used in the second phase of this study. Creswell (2015:16) describes qualitative research as “an inquiry process of understanding based on distinct methodological traditions of inquiry that explore a social or human problem. The researcher builds a complex, holistic picture, analyzes words, reports detailed views of informants, and conducts the study in a natural setting.” In order to holistically understand indigenous-western antihypertensive therapies usage, the qualitative methodology was adopted for this study where participants were interviewed on the “how” and “why” the use of such therapies or the management of hypertension. Qualitative research comprises checking the qualities or characteristics that are not possible to be presented in numerical value. It is a kind of study that has focused on the phenomena that occur within natural settings and comprise studying of such phenomena within all the complexity (Creswell 2015:16).

A qualitative methodology was used in this study to get to know the actual perception of the population sampled for the use of indigenous-western anti-hypertensives among hypertensive patients in Belize. Similar to any other qualitative research, the study was field focused. Scholarly literature shows that qualitative studies are usually exploratory in their natures and might comprise interviews or focus groups (Wilson 2013:275).

Qualitative data were collected from two different sources in this phase. Data were collected from hypertensive patients and herbal remedies vendors using semi-structured interview questions. Face-to-face interviews were used to collect data from selected vendors of indigenous therapies. Phase II data collection was done qualitatively by majorly using interviews from standardized semi-structured pretested questions. The phase explores questions such as why, how, and how often hypertensive patients use indigenous-western therapies and whether hypertensive patients use them as combinations or not. The design also allowed the researcher to know how cultural influence affects indigenous-western antihypertensives' usability among hypertensive patients in Belize.

The study's qualitative section was designed to gather data from antihypertensive patients and vendors involved in selling indigenous remedies. A qualitative interview occurs when researchers ask one or more participants general, open-ended questions, and record their answers. The researcher then transcribed and typed the data into a computer file for analysis (Creswell 2015:217). General information regarding indigenous remedies used to treat hypertension and their efficacy shall be obtained from indigenous vendors using one-on-one interviews. Creswell (2015:218) defined one-on-one interviews as a data collection process in which the researcher asked questions to and recorded answers from only one participant in the study at a time. Information regarding usage and interactions was obtained from the patients using one-on-one interviews. The interview was designed to explore why, how, and how often participants use indigenous remedies to treat their hypertension.

3.7.2.1 Phase II: Sample and sampling technique

A non-probability purposive sampling technique was used for this phase, as described by Creswell (2015:324). Data saturation determined the number of participants in this phase. Data saturation is the stage at which no new information is coming during the interview. A total of 24 hypertensive patients who indicated that they were using indigenous therapies to manage their hypertension were purposively selected from the phase I study. In addition, a total of 19 indigenous therapy vendors were purposively selected and interviewed from the entire country. The information of the vendors was obtained from the traditional healers association of Belize. In qualitative research, the people or sites that can best help understand the central phenomenon are selected (Creswell 2015:206). For the second phase of this study, purposeful sampling was used to select participants for data collection. Participants were selected based on their involvement as vendors for indigenous therapies or as hypertensive patients who use indigenous therapies. Market places and designated sales points were targeted for sample collection. Mark (2010:3) reported that qualitative research is majorly concerned with meaning and not for generalized statements. Qualitative samples, therefore, must be large enough to assure that most or all of the perceptions that might be important are revealed, but at the same time, if the sample is too large, data becomes repetitive and eventually superfluous. The sample size in most qualitative studies should generally follow the saturation concept when the collection of new data does not shed any further light on the issue under investigation. As a result of the numerous factors that can determine sample sizes in qualitative studies, many researchers shy away from suggesting what constitutes a sufficient sample size. Although the idea of saturation is helpful at the conceptual level, it provides little practical guidance for estimating sample sizes for robust research before data collection" (Mark 2010:3). Mark (2010:3) further reported that other researchers had suggested guidelines for qualitative sample sizes. Charmaz (2006:114) suggests that "25" participants are adequate for smaller projects while according to Ritchie et al. (2003:84), qualitative samples often "lie under 50"; while Green and Thorogood (2004:120) stated that "the experience of most qualitative researchers is that in interview studies little that is 'new' comes out of transcripts after you have interviewed 20 or so people" (Mark 2010:3). While some researchers offer qualitative sample guidelines, there is evidence that suggests others do not strictly adhere to them. Creswell's (2015:128) suggested a range of 20 and 30. Therefore, based on the above, this study purposively selected 24 and 19 participants from both hypertensive patients and indigenous therapy vendors in Belize, respectively.

3.7.2.2 Phase II: Population

All hypertensive patients in Belize willing to participate in the study had the opportunity to participate in this phase. Eligible participants were purposively drawn from each district to participate in the study. The need to get participants from the entire country became paramount because of the diversity in cultural beliefs and usage of indigenous therapies usage. For instance, even though every ethnic group is represented in the entire country, some ethnic groups are predominantly in some regions. The Garinagu are concentrated in the Stann Creek area, while the Mayans in the far southern part of the Toledo district. The northern part of the country has a higher concentration of Hispanics, while the Mestizos and Creole are in the country's western and eastern parts.

Although the information on indigenous therapies is shared among the people, some ethnic groups are known to use specific therapies unique to their culture (Ballick and Arvigo 2015:14). A group of 24 hypertensive patients from different parts of the country and different ethnicities were purposely selected from phase I to participate in the second phase of the study. In addition, 19 vendors of indigenous therapies were purposefully selected in collaboration with Belize's traditional association.

3.7.2.3 Phase II: Sampling

A non-probability purposive sampling technique was used for the selection of research participants in this phase. Purposive sampling is defined as a technique of selecting a sample based on specific purposes to answer the study's questions (Teddlie and Yu 2007:77). With a purposive sampling technique, participants in a given unit were chosen based on a specific purpose. It has been considered as a useful sampling method that involves receiving relevant information from a sample population that the researcher believes are aware of the matter being investigated (Li 2004: 305). In this case, the study participants were selected based on pragmatic considerations, such as their availability and willingness to participate in the research. Since non-probability purposive sampling was used for this phase as described by Creswell (2015:324), data saturation determined the number of participants in this phase. Data saturation is the stage at which no new information is coming during the interview. A total of 24 hypertensive patients purposely selected from phase I were interviewed to get diverse and rich responses to indigenous therapies used in managing hypertension. A total of 19 indigenous therapy vendors were also interviewed from the entire country. In qualitative research, the people or sites that can best help understand the central phenomenon are selected (Creswell 2015:206). For the second phase of this study, purposeful sampling was used to select participants for data collection. Participants were selected based on their involvement as vendors for indigenous therapies or as hypertensive patients who use indigenous therapies. Market places and designated sales points were targeted for sample collection. Mark (2010:3) reported that qualitative research is majorly concerned with meaning and not making generalized statements. Qualitative samples, therefore, must be large enough to assure that most or all of the perceptions that might be important are uncovered, but at the same time, if the sample is too large, data becomes repetitive and, eventually, superfluous. The sample size in most qualitative studies should generally follow the saturation concept when the collection of new data does not shed any further light on the issue under investigation. As a result of the numerous factors that can determine sample sizes in qualitative studies, many researchers shy away from suggesting what constitutes a sufficient sample size. Although the idea of saturation is helpful at the conceptual level, it provides little practical guidance for estimating sample sizes for robust research before data collection" (Mark 2010:3).

In the same vein, Mark (2010:3) further reported that other researchers had suggested some kind of guidelines for qualitative sample sizes. Charmaz (2006:114) suggests that "25” participants are adequate for smaller projects while according to Ritchie et al. (2003:84), qualitative samples often "lie under 50"; while Green et al. (2004:120) stated that "the experience of most qualitative researchers is that in interview studies little that is 'new' comes out of transcripts after you have interviewed 20 or so people" (Mark 2010:3). While some researchers offer qualitative sample guidelines, there is evidence that suggests others do not strictly adhere to them. Creswell (2015:128) suggested a range of 20 and 30. Therefore, based on the above, this study purposively selected 24 and 19 participants from indigenous therapy users for hypertension and indigenous therapy vendors in Belize, respectively. The sample for this phase of the study was selected from two different populations.

First, the hypertensive patients who participated in phase one of this study were purposively selected for the qualitative phase. Participants who indicated that they use indigenous therapies to manage their hypertension, willing to participate in phase II of the study, and voluntarily gave their informed consent were selected for the qualitative phase. Second, vendors of indigenous therapies were purposively selected from all over the country, and data on indigenous therapies were obtained. All the registered vendors were included in the study. Data were collected from those who gave their informed consent and when data saturation was reached. Because of the diversity in Belize's culture and the fact that not many vendors of indigenous therapies are found in the country, most indigenous therapy vendors identified were interviewed. Data were collected on indigenous therapies to used to manage hypertension.

3.7.2.4 Phase II: Data collection

Data were collected via interviews using well-structured questions as an interview guide. Creswell (2015:218) defined one-on-one interviews as a data collection process in which the researcher asked questions to and recorded answers from only one participant in the study at a time. On the other hand, a focus group interview collects data through interviews with a group of people, typically four to six. Information regarding usage and interactions was obtained from the patients using face-to-face interviews. The interviews were designed to explore why and how often patients use indigenous remedies to treat their hypertension, methods of preparation, dosing, shelf-life, and side effects.

3.7.2.5 Phase II: Data collection approach

The researcher collected data through an interview. Creswell (2015:204) describes qualitative research as involving checking on the qualities or characteristics that are not possible to be presented in numerical value. It is a study that focuses on the phenomena that occur within natural settings and comprises studying such phenomena within complexities. Within the context of this study, literature has offered suggestions that systematic and structured approaches are very crucial in tackling the potential causes of undesirable performance for the national culture in animation cinemas (Sandelowski et al. 2014:347). Information regarding usage and interactions was obtained from the patients using face-to-face interviews. The interviews were designed to explore why and how often patients use indigenous remedies to treat their hypertension.

Data were collected from indigenous therapy vendors and hypertensive patients using a structured face-to-face interview guide in this phase. The research supervisor and other researchers critiqued the questions to ensure trustworthiness. Two sets of data were collected in this phase of the study.

Data were first collected from hypertensive patients using indigenous therapies. The participants who used indigenous therapies for their hypertension were identified during phase I of the study. Although consent was sought during the first phase of the study, consent was still sought during the qualitative data collection, while strict ethical protocols were observed during the entire data collection process. Interviews were done in a place and at a time convenient for the participants, with field notes taken. The second set of data for this phase was also collected from indigenous therapy vendors. Interviews were conducted based on the convenience of indigenous therapy vendors. These sections of the study explored and described the sources of indigenous therapies and how they were prepared, used, and stored by the vendors for use as antihypertensive therapies.

Interviews used for data collection brought salient issues on indigenous-western therapies to light. A qualitative interview occurs when researchers ask one or more participants general, open-ended questions, and record their answers. The researcher then transcribed and typed the data into a computer file for analysis (Creswell 2015:217). General information regarding indigenous remedies used to treat hypertension and their efficacy were obtained from indigenous vendors using one-on-one interviews.

3.7.2.6 Phase III: Development of the interview guide

Two different instruments were used for this phase of the study because two different data sets were collected. An interview guideline was used to collect data from hypertensive patients using indigenous-western therapies. Another interview guideline that collected data from indigenous therapy vendors was employed. Interview guides were developed to address salient issues on indigenous-western antihypertensive usage in Belize. The interview guides were scrutinized by the research supervisor and other research experts before used for the study.

3.7.2.7 Characteristics of the data collection instrument

The interview guidelines for both interviews with hypertensive patients involved in indigenous therapies and indigenous therapy vendors had an introductory part and an interview section where the main research question and the probing questions were. The introductory part welcomed the participants and informed them of the study's focus and confidentiality and informed consent issues. The interview section had questions on the main research objective as well as eight probing questions. The final section of the questionnaire had a conclusion where participants were thanked for their voluntary contributions. Both interviews took 20 to 40 minutes per participant.

3.7.2.8 Phase II: Data collection process

In this phase, data were collected from hypertensive patients and indigenous therapy vendors using structured face-to-face interview guides. Data were collected via interviews using well-structured questions as an interview guide, while notes were taken to capture the participants' responses.

3.7.2.8.1 Phase II: Hypertensive patients

Identified hypertensive patients from phase I of the study were followed up and interviewed using the structured guidelines for data collection. A total of 24 hypertensive patients were interviewed on the use of indigenous-western therapies in Belize. Interviews were done in a place and at a time convenient for the participants. Participants' informed consent was still reiterated, and participants were free to either withdraw from the interview at any time without any consequences. Participants also had the right to refuse to respond to any uncomfortable question. Responses were noted and later transcribed electronically.

3.7.2.8.2 Indigenous Therapy vendors

Data were also collected from 19 indigenous therapies vendors at market places and other identified outlets where vendors sell their indigenous products. The vendors were purposively identified, and their consent was sought and received before the interviews. All the indigenous therapy vendors contacted agreed to participate in the study. In addition, the vendors consented that their names or businesses be mentioned as a form of advertisement to aid in selling indigenous therapies. They cooperated and provided all the information required willingly. The vendors were also willing to give us samples of their products to try, but that was not part of the study's focus. Interview responses were noted and later transcribed electronically.

3.7.2.9 Data analysis

Responses from structured and unstructured qualitative interviews were entered into a computer in order for them to be coded, counted, and analyzed. Creswell (2015:245) describes a computer analysis of qualitative data as a means that researchers use a qualitative computer program to facilitate the process of storing, analyzing, sorting, and representing or visualizing the data. Data collected during in-depth interviews with hypertensive patients were first transcribed, read several times, and coded themes revealed concerning the study objectives.

Transcribing the information, performing categories of summaries, and associations' critical to present data analysis is critical to the research's success. Additionally, a thematic analysis was employed to present a thematic network that provided the general summary of the key themes generated from a given dataset (Elo et al. 2014:1).

As quoted in the literature, thematic analysis helps enhance understanding of some given phenomenon and promotes the aspect of accurate interpretation of the data collected during fieldwork, leading to more in-depth explorations and more explanations. Themes (also called categories) are similar codes aggregated together to form the database's main ideas (Creswell 2015:245).

This research's primary study focus was to explore indigenous-western antihypertensive therapies among hypertensive patients in Belize. Therefore, a combination of both categorical and holistic strategies was essential based on the fact that the researcher first made a quantitative analysis based on the type of indigenous western anti-hypertensives used and then made the analysis of qualitative data from observations and interviews using categorical strategies for patients using indigenous-western antihypertensive therapies in Belize. The kind of categories initiated in this case acted as a guide for analysis. A holistic analysis was employed to reveal the general patients' perception regarding the concomitant use of indigenous-western medications in this study. This approach is more appropriate, especially after developing categories since the researcher can narrate individual respondents' perception and compare it with the observed behaviors in that respect. Clarke and Braun (2017:120) outlined that the two analysis strategies are not by any chance exclusive to one another. Summarily, the following steps were used for data collection as described by Creswell (2015:245):

- The interviews from both herbal remedies hypertensive patients and indigenous therapy vendors were organized, prepared, and arranged meaningfully according to sources and types. A thorough study of the interviews revealed the participant's general impressions and connotations.
- The information was then categorized, labeled, and organized into smaller components with clearly defined coded themes identified and described.
- Information was analyzed using the software QDA Miner Lite version 2.6 for thematic analysis. Miner Lite is a free software for analyzing qualitative data. It is utilized to tag texts that are related to specific codes in each question. Coding aids in unifying data into groups (nodes) or themes so that data from diverse sources can be ordered and integrated. With significant themes coded in this manner, the researcher can later scrutinize and extract inspiring pieces and treat them as separate records (Akinyode and Khan

2018:3).

- Finally, meanings were attached to the theme and commonly used words chronologically described by the participants to provide more precise meanings of themes resulting in data interpretation.

Data on indigenous-western remedies usage among the Belizean population was then integrated to incorporate findings from phases one and two (Creswell, 2015:245). Detailed integrated findings from all phases are presented in chapter five.

3.8 PHASE II: RIGOR OF THE STUDY

3.8.1 Data trustworthiness

The process to ensure dependability, credibility, transferability, and confirmability in qualitative research is referred to as trustworthiness (Lincoln and Guba 1985:308). In this study, the qualitative section's trustworthiness was ensured through credibility, transferability, dependability, and confirmability strategies. The Lincoln and Guba (1985:308) model was applied for this research, and some of the issues considered to ensure trustworthiness are as follows:

3.8.1.1 Credibility

The confidence that can be placed in the truth of a qualitative research finding is defined as its credibility (Anney 2014:276). To ascertain whether or not the research finding corresponds to the information obtained from research participants' original data and is an accurate representation of participants, the credibility of the data needs to be ensured (Graneheim and Lundman 2004:105). In this study, triangulation, peer briefing, and member check credibility strategies were adopted to establish asperity in this phase of the study.

3.8.1.2 Triangulation:

Using multiple data sources to provide a better understanding is referred to as triangulation (Creswell and Miller 2000:124; Creswell 2015:259). Triangulation is the process of corroborating evidence from different individuals, types of data, or data collection methods in descriptions and themes in qualitative research. In order to facilitate a deeper understanding of research outcomes, multiple methods are adapted because a single method usually does not shed adequate light on the phenomenon (Angen 2000:378; Mays and Pope 2000:50). Triangulation methods, where the consistency of findings generated by different data collection methodologies defined as methods triangulation, are utilized in this study (Patton 1999:1189). Methods triangulation in this study involved having quantitative and qualitative data elucidated complementary aspects of the study where the diverged data provided deeper insights than a single data collection method.

3.8.1.3 Peer briefing

Lincoln and Guba (1985:308) defined peer briefing as a process of exposing the research outcome to a disinterested peer in a way comparable to an analytical session and for the intention of exploring aspects of the study that might otherwise only implicit within the inquirer’s mind. Peer briefing was done to ensure the credibility of the study.

3.8.1.4 Member Checks

Member checking was defined as a process in which the researcher asked one or more participants in the study to check the accuracy of the information. This check involves taking the findings back to participants and asking them about the report’s accuracy (Creswell 2015:259). To assess the adequacy of the data and preliminary research results and confirm particular aspects of the research data, member checks shall be done to provide such opportunities to respondents. Member checks, therefore, was used to check the credibility of the data collected for this study.

3.8.1.5 Transferability

Bitsch (2005:75) defines transferability as the degree to which qualitative research results can be transferred to other contexts with other respondents. The interpretive equivalent of generalizability is transferability (Tobin and Begley 2004:388). In transferability, Bitsch (2005:85) and Anney (2014:278) reported that "the researcher facilitates the transferability judgment by a potential user through 'thick description and purposeful sampling."

3.8.1.6 Thick Description

The judgments of how well the research context fits other contexts are defined as a thick description (Li 2004:305). A detailed account of methodology, experiences, relationships, patterns, and context about the research needs to be reported by the researcher (Anney 2014:278). The entire research process from data collection, the study's context, and the final report are elucidated with thick descriptions. Providing thick descriptions helps other researchers replicate the study using related premises and different settings (Shenton 2004:63). Therefore, to ensure this study's trustworthiness through transferability, a detailed description of the inquiry was kept from the beginning and throughout the study.

3.8.1.7 Dependability

The stability of research findings over time has been defined as dependability (Bitsch 2005:86). Participants were allowed to evaluate the findings, interpretation, and recommendations of the research to ensure consistency and agreement from the respondents of the study (Anney 2014:278; Creswell 2015:259). The goal of dependability is to ensure that research findings are consistent with informants' information and that data can be replicated. In order to ensure the dependability of the current study's inquiry, code-agreement and peer examination were employed in this study.

3.8.1.7 Code-agreement

The data collected for the study were coded twice and given space in between the first and second coding. The results of the coding were compared for consistency or lack of it. When the coding results agree, it enhanced the inquiry's quality's dependability while helping the researcher gain a better understanding of data presentations and patterns (Anney 2014:278). This process provided an evaluation of whether or not findings, interpretations, and conclusions were accurate and supported by the data (Creswell 2015:259).

3.8.1.8 Peer examination

The entire process of the research process, data collection, results, interpretation, and conclusions, was discussed with peers. The discussion was honest to allow critique and contribute to a more in-depth reflexive analysis of the entire research process (Bitsch 2005:86). Research experts, including the research supervisor, were frequently consulted at each stage of the study for corrections and criticism of the overall research process at different stages (Gysels et al. 2013:107). Peer examination of the current study also provided feedback on aspects of research categories and questions not covered by the researcher (Anney 2014:279).

3.8.1.9 Confirmability

The degree of neutrality and the extent to which other researchers could corroborate research findings is referred to as confirmability (Anney 2014:279). The goal of confirmability is to ensure that the data and interpretation of findings were not influenced by the researcher's bias, interests or motivation, but were obtained purely from the data (Tobin and Begley 2004:392). This study's research process was checked for confirmability through triangulation, as described earlier, and through a reflexive journal.

3.8.1.10 Reflexive Journal

The reflexive document is a diary kept by the researcher, where regular entries are made to reflect on, interpret, and for a data collection plan (Wallendorf and Belk 1989:218). The journal usually includes records of methodological decisions, the study's logistics, and the reasons for decisions taken and reflected on their background, beliefs, perceptions, values, and interests (Anney 2014:279). In order to avoid personal bias and improve the integrity of the research inquiry, an honest assessment of the researcher's values, preconceptions, beliefs, position, and assumptions during the research process was documented. In this study, a reflexive journal was kept to ensure that the researcher's preconceptions do not come into play with the research process.

3.9 DEVELOPMENT OF THE GUIDELINES

Guidelines on the use of indigenous-western antihypertensive remedies were developed at the end of phase 2 of the study. The guidelines utilized information obtained from all the results in both phases I and phase II studies. In developing these guidelines, the study adopted triangulation principles to combine quantitative data with qualitative data to produce guidelines for the use of indigenous-western antihypertensive therapies in Belize. The guidelines included part of the plants used for hypertension management and methods of processing indigenous therapy. Also, Western medications commonly prescribed for hypertensive therapy were documented, including concomitant use with indigenous therapies and reported interactions from other literature.

Guidelines for the use of indigenous-western hypertensives were established based on the explanatory sequential mixed-methods design. Creswell and Clark (2017:54) described an explanatory sequential mixed methods design consisting of first collecting quantitative data and then collecting qualitative data to explain or elaborate on the quantitative results. This approach's rationale is that the quantitative data and results provide a general picture of the research problem; more analysis, specifically through qualitative data collection, is needed to refine, extend, or explain the general picture. In this method, Creswell (2015:542) further classified three ways to mix the data from an explanatory sequential method.

First, the priority of quantitative data (QUAN) collection and analysis are considered by introducing it first in the study and having it represent a significant aspect of data collection. A small qualitative (qual) component typically follows in the second phase of the research. Second, quantitative data were first collected in the sequence. This is followed by secondary qualitative data collection. This was presented in two phases, with each phase identified in headings on the report. Third, the qualitative data are used to refine the results from the quantitative data. This refinement results in exploring a few typical cases, probing a fundamental result in more detail, or following up with an outline.

The merging or mixing of the data was done by triangulation. Creswell (2013:542) described triangulation "as a means that investigators could improve their inquiries by collecting and integrating different kinds of data bearing on the same phenomenon." The three points to the triangle are the two sources of the data and the phenomenon. This improvement in inquiries came from blending the strengths of one type of method and neutralizing the weaknesses of the other. This study adapted the triangulation principles to combine quantitative data with qualitative data to produce the guidelines used for indigenous-western antihypertensive therapies in Belize. The guidelines also included part of the plants used for hypertensive management, how to process the indigenous therapies, the recommended dosage, how the therapies should be taken, and reported adverse effects or interactions when used with Western medicines. This section of the study, therefore, provided the much-needed guidelines for public safety and healthcare professionals. The section also provided useful suggestions for future investigations into the use of western- indigenous medicines in Belize.

3.10 Ethical considerations for this study

Ethical research aims at providing safe and secure protection of the research participants and the subsequent publication of the gathered information (Creswell 2015:22). In the general process of planning and doing research, and in reporting the research findings, the researcher fulfilled the following responsibilities for the study as such considered as having met the required ethical standards set forth by the international bodies of research (Wilson 2013:275).

3.10.1 Planning

The first and initial thing was planning for the whole research project, minimizing the chances of getting results, which are misleading (Salkind 2010). The second step was all about having an ethical plan so that the research met the ethical acceptability. At this point, an extensive literature search on indigenous therapies and Western medications was conducted to remove any doubts that the researcher may have concerning questionable ethical methods or procedures. Peer review and consultation with the appropriate parties, like in this case, the supervisor and university of South Africa institutional review committee, was done.

3.10.2 Ethical Permission

Ethical permission was sought and obtained from relevant authorities before carrying out the scientific study as it is obtainable with best research practices (Wisdom et al. 2012:275). In this study, ethical permission was sought and obtained from the UNISA ethical review committee and the University of Belize. Upon getting permission, the study participants' general welfare and dignity were respected during the study's conduct. Additionally, the dignity of many other people who can be affected by the research project results was considered and respected. Mulvey (2015:477) summarized the three main ethical principles that should always be applied in any research to ensure that all human participants are respected and protected. The principles in this case comprised of respect for persons, justice, and beneficence. Ethical Conduct for Research involving human participants provided by the UNISA institutional board review (IRB) was duly followed, and necessary approvals secured before the study's commencement.

3.10.3 Informed consent

The primary ethical consideration in conducting research is informed consent. Informed consent seeks to provide adequate information to the participants regarding the purpose, objectives, and significance of the research to intelligently, knowingly, and voluntarily consent to their participation. With informed consent, the subjects' rights, autonomy, and personal liberty to partake in the research with clarity and veracity are provided. Consents were obtained from each participant before the administration of the questionnaire. Active (or passive) consent was necessary depending on the disposition of the participant.

During data collection, each participant was informed about confidentiality, anonymity, volunteer, the freedom to withdraw from the study at any point without any consequence, and the fact that no incentives are associated with participation other than the service they offer to help make Belize public healthcare system better. The study, however, had the advantage that it has no known risk.

Participants were duly informed about their rights to participate and withdraw from the study at any time. The study's purpose and significance were explained to the participants, and consent was sought and received before the study's commencement. Participants were told about the fact that participating in the study comes with no risk. Names or identifiers were not used except for those volunteering to participate in the qualitative study. Researcher's contact details were given, and the participants duly signed consent forms or provided oral consent. The primary reason for consent agreements is to provide evidence that the participant agreed to participate in the study (Creswell, 2015:247).

3.10.4 Security of data

Finally, the collected questionnaires and consent forms were immediately secured, and same transported for analysis. Collected questionnaires and consent forms were kept under key and lock, and data entered into the computers were password-secured. All information regarding the research was filed and kept for a period specified by the institutional research ethics board.

The principal ethical requirements during this kind of study were strictly upheld without any intrusions. Since the study also involved reviewing secondary data, especially from books, government records, policy statements, academic journals, and articles, the literature's authors were also acknowledged through text citation and referencing for conformity to plagiarism policy. The gathering of information from such documents was conducted using a systematic review designed with the utmost integrity and responsibility and at the same time avoiding any form of related misconduct. The analysis and synthesis of other people's ideas were done to respect the copyright-related regulations on the primary sources of data. Presenting a work that has been plagiarized and has redundant duplications, contravening general guidelines and ethics, and borrowing data from reports that have insufficient ethical standards was avoided (Mulvey 2015:477). To avoid these, all resources that contributed to the development of this dissertation were recognized through in-text citation and by being included in the reference list.

3.11 Summary

This chapter presents the research design, methodologies, and analytical approaches used for gathering both phases of the data. This study employed a mixed-methods explanatory sequential design through which data were collected using quantitative and qualitative procedures. For phase I research, a descriptive quantitative research design was used. A well-structured validated questionnaire was used for data collection. The results were analyzed using SPSS v.21, and data presented using frequency tables, charts, and graphs. For phase II of the research, on the other hand, an exploratory qualitative research design was employed, and interviews using semi-structured questions as guidelines were used for data collection. Thematic analysis was used to analyze the data and results presented based on themes. Finally, the chapter presents all the ethical considerations applied in conducting this research.

CHAPTER 4

ANALYSIS, PRESENTATION, AND DESCRIPTION OF THE RESEARCH FINDINGS

Quantitative data collection and results (Phase I)

4.1 INTRODUCTION

The previous chapter focused on the different methodologies used for data collection and analysis. This chapter presents the data collection, analysis, and results from 422 questionnaires completed by hypertensive patients in Belize in the first phase of the study. The purpose of the phase was to examine indigenous-western antihypertensive therapies use among Belizeans.

The objectives of this phase were:

4.1.1 Phase 1: Quantitative phase

- To determine the indigenous-western therapies used to manage hypertension by patients in Belize.
- To identify the common western therapies used in the treatment of hypertension in Belize.
- To identify concomitant usage of indigenous–western therapies among hypertensive patients in Belize.

Based on the above study objectives, the study answered the following research questions:

Phase I

- What were the common indigenous therapies used by patients to manage hypertension in Belize?
- What were the common western therapies used by hypertensive patients in Belize?
- Do Belizean hypertensive patients combine indigenous – western therapies in the management of their hypertension?

4.2 METHODOLOGY

The researcher used a cross-sectional quantitative survey to collect data from hypertensive patients in Belize, employing convenient sampling. Data were collected using a well-structured questionnaire.

4.2.1 Participants for the study and eligibility criteria

The participants' eligibility in this phase of the research comprised all hypertensive adult patients currently attending government hospitals, private clinics, or community pharmacies. Hypertensive adult patients currently accessing antihypertensive medications at any government-owned hospitals, private clinics, or pharmacies were eligible to participate in the research. Those who consent were included in the study, while others were considered ineligible because they did not consent. Participants were recruited from government hospitals and private hospitals, and pharmaceutical stores across Belize. Consent was first sought from participants before the questionnaire was administered, and the researcher assisted those who could not read or write. Participation was voluntary, without any incentive or pressure from the researcher. Finally, completed questionnaires were retrieved and stored in a secure cabinet for safety. Data collection was divided into two stages: pretesting and administration of the instrument. The confidentiality of respondents' information was maintained at all times. A total of 422 questionnaires were completed from October 2018 to April 2019.

4.2.2 Sample size and sampling procedures

The study employed a convenient sampling technique to obtain data from diagnosed hypertensive patients in Belize. A sample size of 422 was used for the study (Table 4.1). A 95% confidence level with a +/- 5% confidence interval was used to determine sample size. The sample size was determined using the online software Open Epi (Epi Info™), Version 3, open-source calculator—SSPropor (Dean et al. 2013:1)

Table 1.1 Phase I Sample Size calculation.	
Population size (for Finite Population Correction factor or FPC) (N):	398050
Hypothesized % frequency of outcome factor in the population (p):	50%+/-5
Confidence limits as % of 100 (absolute +/- %) (d):	5%
Design effect (for cluster surveys-DEFF):	1
Confidence level (%)	95%
Sample size	384
Equation: Sample size n = [DEFF*Np(1-p)]/ [(d2/Z21-α/2*(N-1) + p*(1 p)]	

Table 4.1 Phase I sample size calculation using OpenEpi (Epi Info™)

4.2.2.1 Sample size calculation: Phase I

OpenEpi (Epi Info™) open-source calculator was used to calculate sample size (Dean et al., 2018:1). OpenEpi (Epi Info™) is a free and open-source software for epidemiologic statistics. It provides statistics for counts and measurements in descriptive and analytic studies, stratified analysis with exact confidence limits, matched pair and person-time analysis, sample size and power calculations, random numbers, sensitivity, specificity and other evaluation statistics, R x C tables, and chi-square for dose-response (Dean et al. 2018:1).

Using the OpenEpi, the country's sample size was calculated and found to be 384 x 10% = 422. The addition of 10% was to take into consideration the non-response factor. Therefore, the final sample size was determined to be 422, with a medium effect size at α = 0.05 level was used.

In order to obtain proportionate samples from the six districts in Belize, the 422 total sample size was further stratified proportionately to get representative samples from each district (Table 4.2).

A total of 422 questionnaires were used for data collection in this phase of the study. A 95% confidence level with a +/- 5% confidence interval was used to determine sample size. The sample size was determined using the online software Open Epi (Epi Info™), Version 3, open-source (Table 4.2). Stratified proportionate samples were further calculated based on the district population, as shown in Table 4.2.

Table 4.2 Sample size based on district – Phase I

District	Population	District Sample size
Belize	120, 602	128
Cayo	96,197	102
Orange Walk	51, 749	55
Corozal	48, 429	51
Stann Creek	43, 452	46
Toledo	37, 614	40

4.2.2.2 Research instrument

After reviewing the literature, the researcher developed a carefully designed questionnaire for the study. Some questions were adapted and modified from previously developed research instruments (TRAMIL 2010:1; Picking et al. 2011:305). The questionnaire was divided into three sections and consisted of 32 items. The first section of the questionnaire dealt with general information from the respondents. Questions addressing age, gender, education level, marital status, income, and religion formed the questionnaire's first section. The second part of the questionnaire focused on collecting information on hypertension diagnosis, medication use, and medication adherence, while the final set of questions explored herbal usage and indigenous-western therapies practice among hypertensive patients in Belize.

- Section A: Demographic data.
- Section B: Western medication usage.
- Section C: Indigenous therapy usage.

4.2.2.3 Piloting and validation of the questionnaire

The questionnaire was first presented to the research supervisor, college professors, health practitioners, and pharmacists for review. Their recommendations led to the inclusion of questions on medication adherence to explain indigenous therapy usage. Furthermore, the item on herbal teas usage was added for respondents who may not be directly consuming indigenous therapies but are taking prepared teas to manage their hypertension. The questionnaire was then piloted in 35 hypertensive patients in Belmopan to check for errors. Some spelling and grammatical errors have been corrected. The skip option was further added to individuals who indicated they did not use indigenous therapies for their hypertension.

The questionnaire was also validated using a statistical method. Reliability testing of the questionnaire showed a Cronbach's alpha value of 0.779. An exploratory factor analysis (EFA) using principle component analysis extraction and direct oblimin rotation with Kaiser Normalization was also employed, which extracted five components. The Kaiser Mayer Olkin (KMO) measure of sampling adequacy and Bartlett's test for sphericity was also employed, which reported a value of 0.6 and a significant *p-value* less than 0.001, respectively. Therefore, based on the statistical validation, the questionnaire was divided into three sections: demographic information, hypertension, and medication usage, and indigenous-western therapies usage. In this regard, the questionnaire was considered validated and used for data collection for this study phase.

4.2.2.4 Data analysis

Coding of data was done before being analyzed in a computer package Statistical Package for the Social Sciences (SPSS) version 21.0 software. The researcher reviewed all collected data to ensure consistency, readability, and completeness. Mistakes from respondents were checked or corrections made as deemed necessary (Clarke and Braun 2017:120).

Descriptive statistics was primarily used to describe demographic data and research questions based on prevalence, while inferential analyses were used to explore relationships. The main descriptive statistical procedures used were frequencies and percentages, and the main inferential statistics were χ^2 and t-test. The responses on indigenous-western therapies were analyzed using version 22 of SPSS (Statistical Package for Social Sciences) (IBM Corp., Armonk, NY, USA). The data were analyzed for frequency counts, and cross-tabulation was performed on associations. The chi-square (X^2) test was used to identify and report statistically significant associations. Prevalence was calculated and reported in terms of 95% confidence interval values. An alpha margin of error (α) was identified at 0.05.

4.2.2.5 Response rate

Harrison, Henderson, Alderdice, and Quigley (2019) reported a general decrease in survey response rates. The current study's response rate was not in agreement with Harrison et al. (2019) since a 100% response rate was achieved. All 422 questionnaires distributed were received, giving a cumulative response rate (RR) of 100% for this study phase. The 100% RR could be attributed to the culture of the people who always wanted to offer help, and the majority of the respondents did not take the questionnaire home but completed the questionnaire immediately. The research's objective was clearly explained to the respondents, and support was given to those who could neither read nor write.

4.2.2.6 Demographic data

This section of the questionnaire covered demographic data such as age, gender, marital status, religious affiliation, ethnicities, districts, education, employment, and income of the patients. The demographic data helped to contextualize the overall result in making useful recommendations for the use of western-indigenous therapies among hypertensive patients in Belize.

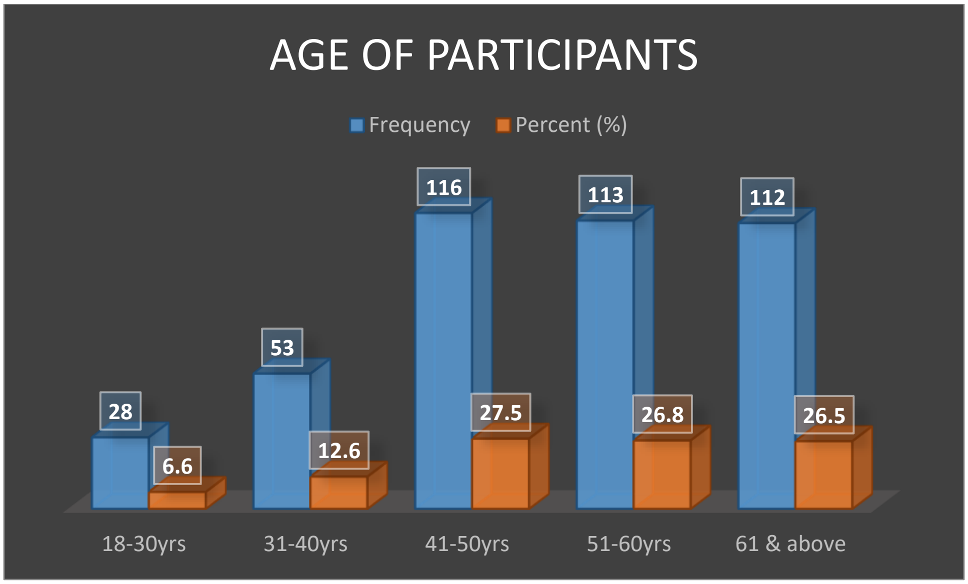

Fig. 4.1 Age of participants

The age range of patients with hypertension in this study was between 18 and 61 years and above, with the age category 41 and 50 years having the highest number of respondents (n=116; 27.5%). The risk of developing hypertension increases with an increase in age. Age-related increases in blood pressure are widely reported and accepted features of aging. In the western, systolic blood pressure has been reported to increase by approximately 7mmHg from 40 years and above. Epidemiological studies have shown an increase in age-related systolic blood pressure that is progressive, reaching an average of approximately 140 mmHg in the 80th year (Gurven, Blackwell, Rodriguez, Stieglitz, and Kaplan 2012:25).

Age-related hypertension reported cases in this survey are in agreement with previous studies on age-related hypertension in Belize. For instance, PAHO (2009:22) reported a national survey on the prevalence of hypertension distribution on age to be 40-64 (42.8%) and 65 years and older (35.1%) was 2 to 3 times higher than among persons 20-39 years. Respondents of White (42.0%), mixed (37.2%), East Asian (37.1%), Garifuna (36.2%), and Creole ethnicity (32.4%) had a higher prevalence (Fig. 4.1).

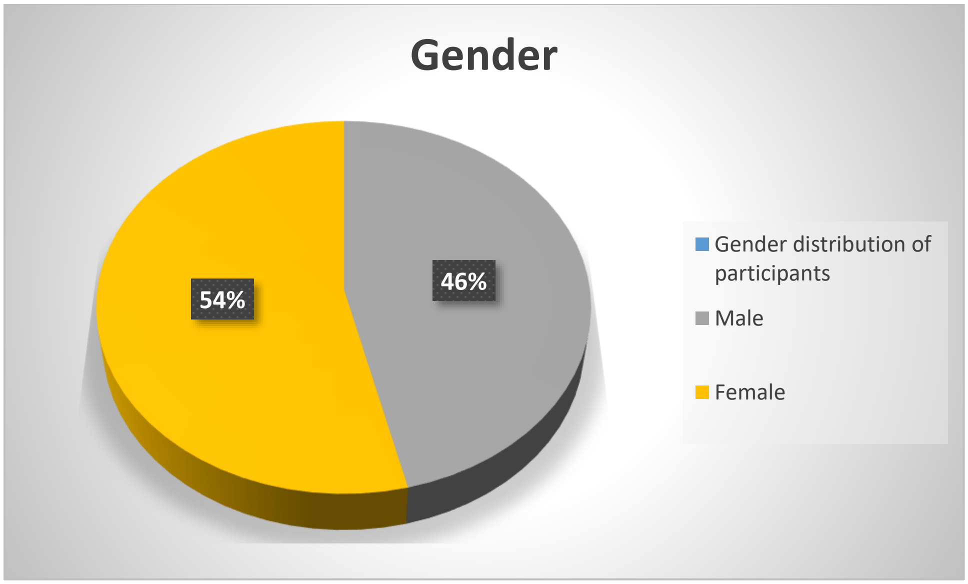

Fig. 4.2 Gender distribution of participants

422 (53.8%) of respondents in this study were female, representing a frequency of 227 (Fig. 4.2). Currently, Belize's 2019 mid-term estimated population puts the male to female data at 247 to 204 (SIB 2019:1). Although population-wise, the females in Belize were not more than the males; there seem to be higher reported cases of hypertension in females than in males in this study.

The general perception of gender-based hypertension is that it is the most prevalent disease in men. Contrary to this belief, most cardiovascular diseases, including hypertension, are higher in women than men. Menopausal women have been reported to have a higher incidence of hypertension compared to other women. Furthermore, women have been reported to have uncontrolled hypertension and experience higher incidences of cardiovascular diseases later in life. The higher prevalence of hypertension in females has been attributed mostly to hormonal changes and longevity seen in women than in men (Rahman, Williams, and Al Mamun 2017:23; Abramson and Melvin 2014:553; Doumas, Papademetriou, Faselis, and Kokkinos 2013:321). The present study results corroborated the report indicating that females have a higher prevalence of hypertension than men. In 2009, PAHO published national survey data on diabetes, hypertension, and chronic disease risk factors in Belize to further illustrate this.

The report indicated the highest prevalence of hypertension among women in Stann Creek (35.3%), Belize (34.6%), and Orange Walk (33.1%), with the prevalence among women notably high in all six districts as compared to their male counterparts. Even though in the current study, the sample size was much smaller than that of PAHO, the results of the survey were still in agreement.

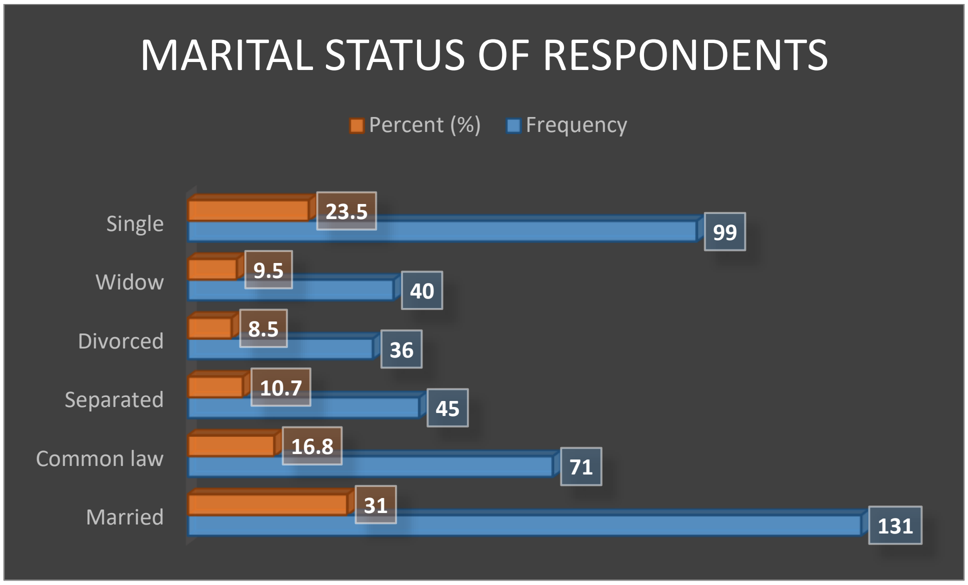

Fig. 4.3 Marital status of respondents

The majority (n= 131; 31.0%) of the respondents were married, while 16.8% (n=71) were in a common law relationship (Fig. 4.3).

A significant predictor of a wide range of health outcomes is the marital status of the individual. It is a vital social factor that has also been associated with cardiovascular diseases, including hypertension. However, several studies have presented conflicting evidence regarding the role of marital status in hypertension. For instance, a study in Ghana (Tuoyire and Ayetey, 2018:313) reported significantly higher odds of hypertension for married (OR=2.14, 95% CI=1.30-3.53), cohabiting (OR=1.94, 95% CI=1.16-3.23) and previously married (OR=2.23, 95% CI=1.29-3.84) women as compared to unmarried.

Manfredini, De Giorgi, Tiseo, Boari, Cappadona, Salmi, Gallerani, Signani, Manfredini, Mikhailidis, and Fabbian (2017:624), however, reviewed 13 studies on the subject matter (accounting for 1,245,967 subjects) and concluded that "most studies showed better outcomes for married persons, and generally, men who were single had the poorest results." They further reported, "being married was associated with lower risk factors and better health status, even in the presence of many confounding effects."

Therefore, the current study results are predictive of the possibility that culture, environmental factors, and religious beliefs play a significant role in the relationship between hypertension and marital status. Further studies need to be conducted in Belize to examine the relationship between marital status and hypertension.

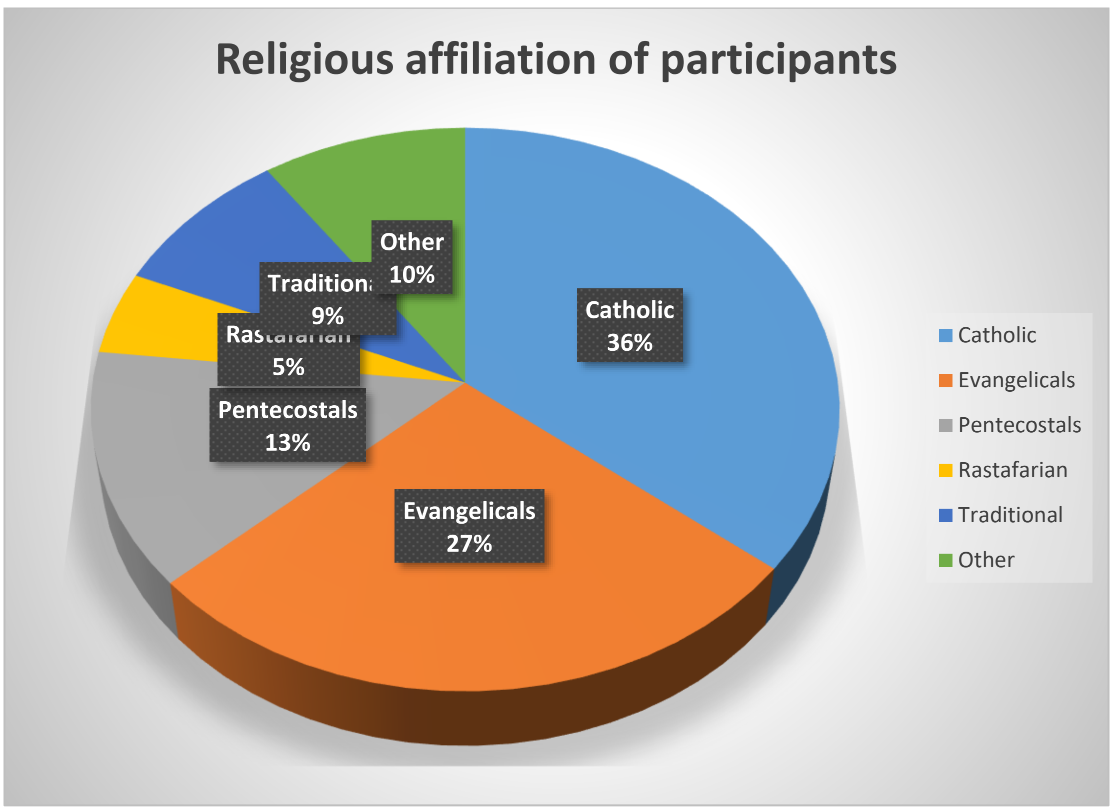

Fig. 4.4 Religious affiliation of participants

In some studies, religion has been reported to have a protective role against hypertension. The religion-related activities such as meditation, vegetarian diets, exercise, smoking abstinence, nut consumption, and social support were mediators indicated to help protect against hypertension (Meng, Xu, Shi, Zhang, Wang, Liu, and Chen 2018:8203; Meng, Zhang, Shi, Liao, and Chen 2019:209; Sherma and Jerry 2016:709). Although the current study did not examine the correlation between religion and hypertension, the results (Fig.4.4) indicated that the highest number of hypertensive participants was Catholics (n=151; 35.8%), followed by the evangelicals (n=116; 27.5%). The high frequency of hypertension seen among the religious organizations in this study could be attributed to factors beyond the scope of this study. Genetic factors, improper nutritional, dietary practices, and lack of adherence to strict religious meditation may contribute to higher levels of hypertension seen among religious participants in this study. The results suggest a need to further explore religion as it affects hypertension in Belize.

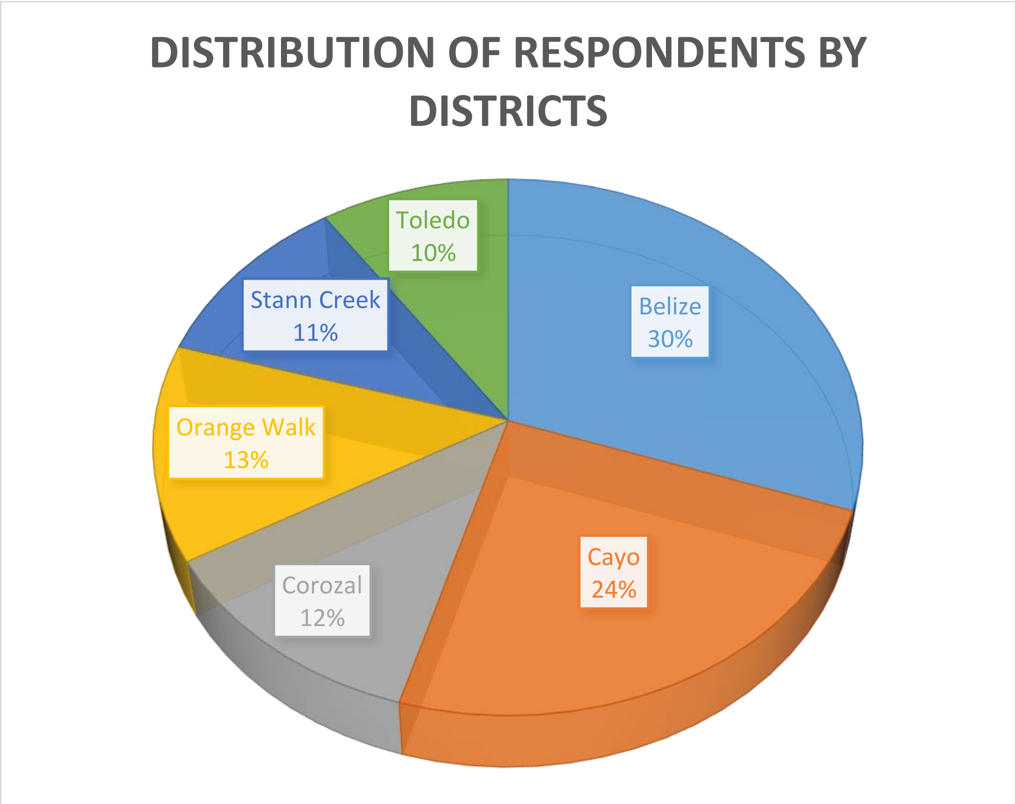

Fig 4.5. Distribution of respondents according to districts.

According to their districts, the respondents were proportionately stratified based on the population data obtained from the Statistical Institute of Belize (SIB). Based on the SIB's data, Belize and Cayo districts had the highest number of people; therefore, sample sizes from these districts were higher than other districts.

Previous studies (PAHO 2009:22) on hypertension distribution in the districts showed a statistically significant relationship between the district of residence and hypertension. The PAHO study reported high (≥ 20.0%) hypertension prevalence in all districts of Belize. The prevalence of hypertension was highest in Stann Creek (35.1%), Belize district (34.1%), and Orange Walk (30.7%), respectively (Fig. 4.5).

Furthermore, the report indicated the highest prevalence of hypertension among women in Stann Creek (35.3%), Belize (34.6%), and Orange Walk (33.1%), although the prevalence among women was notably high in all six districts as compared to their male counterparts. The current study showed that the Belize district had the highest number of participants with hypertension only due to the sample size.

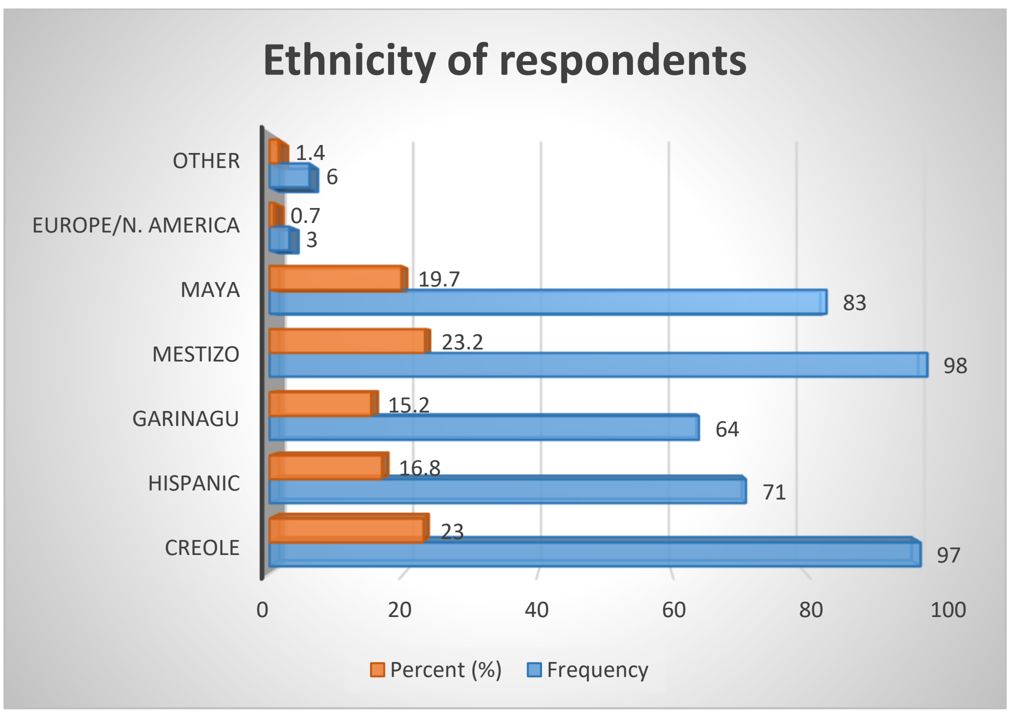

Fig. 4.6 Ethnicity distribution of respondents

Data on ethnicity (Fig.4.6) showed that Mestizo had the highest participants (n=98; 23.2%), followed by Creole (n=97; 23%). The least ethnic group that participated in the study was the Europeans and North Americans (n=3; 0.7%). It should be noted that the number of Westerners living in Belize is in the minority. Conversely, Europeans and North Americans may not have been observed due to other reasons, such as obtaining medications from alternative sources unknown to the researcher.

Ethnicity and ethnic variations have been reported among hypertensive patients, leading to errors in hypertensive management and control (Thomas and Allison 2019:43; Thomas, Pannier, Danchin, and Safar 2019:555). For instance, it is a well-established fact that the black race is especially susceptible to hypertension and its associated organ damage than the white race (James et al. 2014:507). A report on hypertension by PAHO (2009:22) indicated the highest prevalence of hypertension among women to be 40-64 (42.3%) and 65 years and older (64.2%), East Asian women (39.4%), Garifuna (42.3%), mixed (36.5%), white (39.8%) and Creole (34.0%) ethnicity, obese (36.0%) and women who were overweight (29.5%), women with elevated cholesterol levels, and women with waist circumference ≥ 88 cm (35.2%) had a higher prevalence than women without these characteristics. Therefore, the current study results are a confirmation of variations that exist between the ethnicities of hypertensive patients.

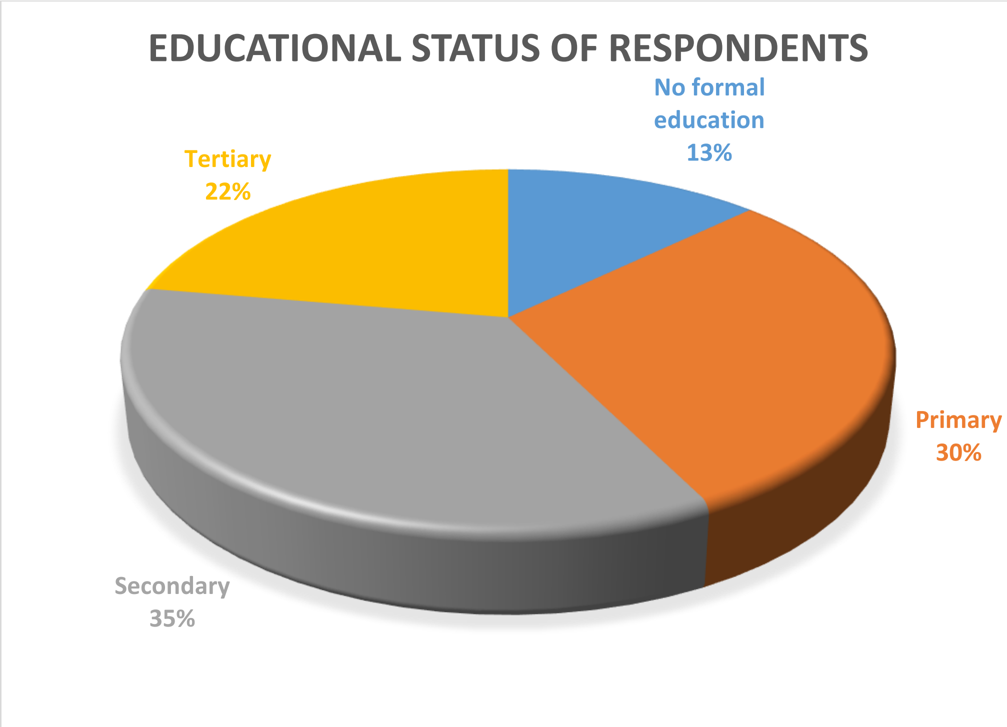

Fig. 4.7 Educational status of respondents

The majority (n= 148; 35.1%) of the respondents attended secondary school, while those without formal education (n=54; 12.8%) had the least participants (Fig. 4.7). Educational attainment has been reported to be associated with risk for cardiovascular disease (CVD), presumably as a marker or mediator of other traditional risk factors (Kubota, 2017:1877; Adler and Glymour 2017:1892). For instance, lower educational status has been reported to be associated with a high prevalence of hypertension (Sarki, Nduka, Stranges, Kandala, and Uthman 2015: e1959).

In this study, primary educational status was associated with higher hypertension levels than participants with no formal education. From the results of this study, the association between hypertension and education level is likely to be mediated by other nonclinical or clinical factors. Nevertheless, awareness of a patient's education status could improve overall clinical assessments and patient counseling (Kubota, 2017:1877; Adler and Glymour, 2017:1892).

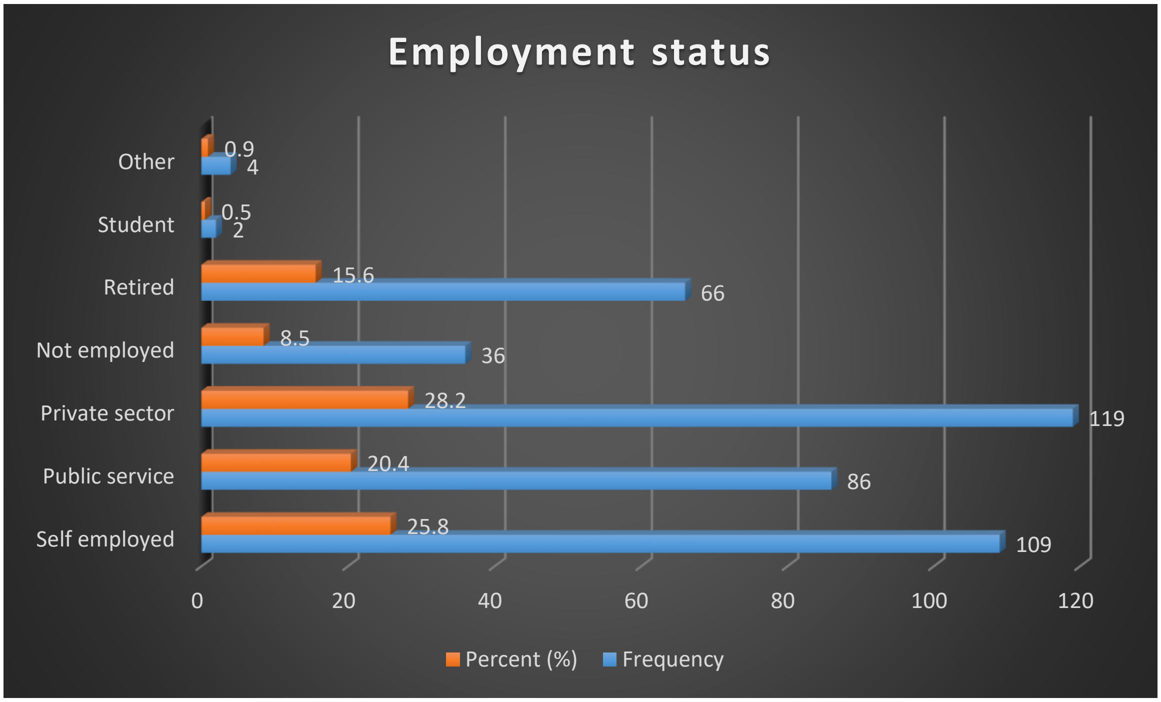

Fig. 4.8 Employment status of respondents

Figure 4.8 shows analyzed data based on the employment status of participants showed the majority (n=119; 28.2%) to be from the private sector; this was followed by self-employed participants (n=109; 25.8%), with the least participants being students (n=2; 0.5%). Most research on employment status with hypertension has been on salaried populations, and the results were conflicting on how employment affects hypertension. Be that as it may, an inverse relationship between workplace and morbidity has been reported. Hypertension and reduced heart disease risks have been shown with higher job status (Amano, Shirakawa, and Hashimoto 2019:10936). In this study, employment status was associated with higher hypertension levels compared to participants with no employment. From the results of this study, the association between hypertension and employment status is likely to be mediated by other nonclinical or clinical factors. Nevertheless, awareness of a patient's employment status could improve overall clinical management, especially regarding purchasing power for pharmaceutical products and other lifestyle changes.

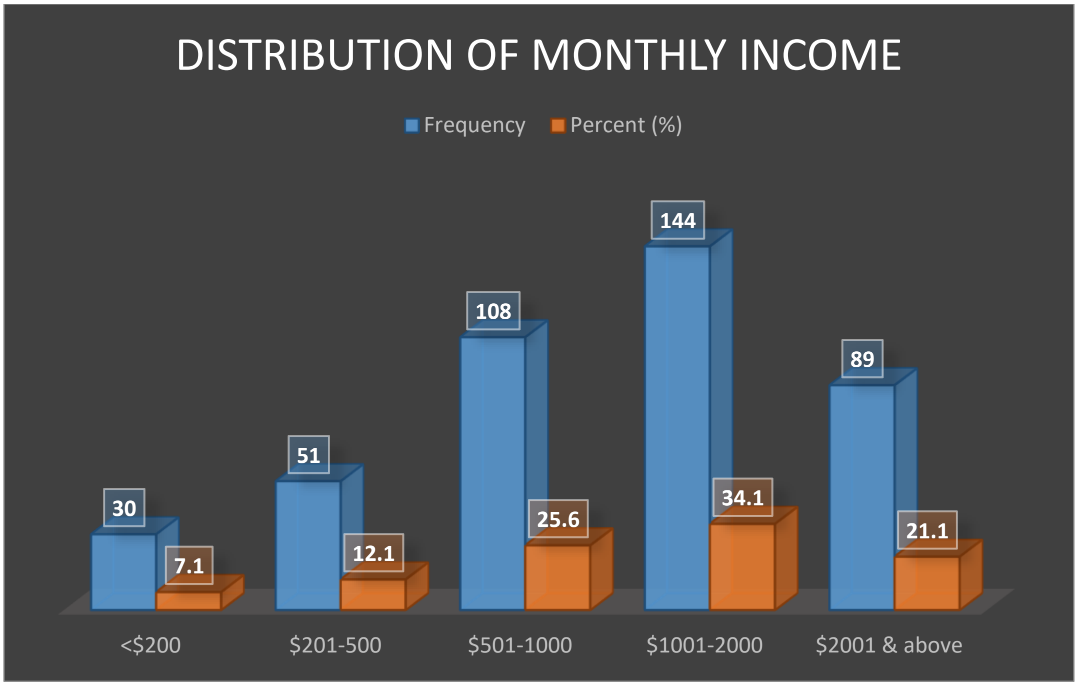

Fig. 4.9 Monthly income distribution of participants

From the current study, results on monthly income indicated that the majority (n=144; 34.1%) of the participants earn between $1001 and $2000 Belize dollars monthly income (Fig. 4.9). The result of this research corresponds with Belize statistical data (SIB, 2019:1), where the median income was reported to be 1,244 Belizean dollars. Information on patients' incomes is essential for effective targeting of health care professionals' interventions and monitoring progress in improving hypertension care. Hypertension rates have been reported to be likely higher in upper-middle-income countries than in lower-middle-income countries, and the latter is more likely to be higher than low-income countries (Sarki et al. 2015: e1959). In this study, the participants' seemingly average income could be directly attributed to their educational attainment and subsequent employment status, as shown in figures 4.7 and 4.8.

4.3 HYPERTENSION DIAGNOSIS AND MEDICATION USE

This section explored the use of antihypertensive medications by respondents. Questions explored the frequency and duration of medication use, medication adherence, and types of medications used by respondents.

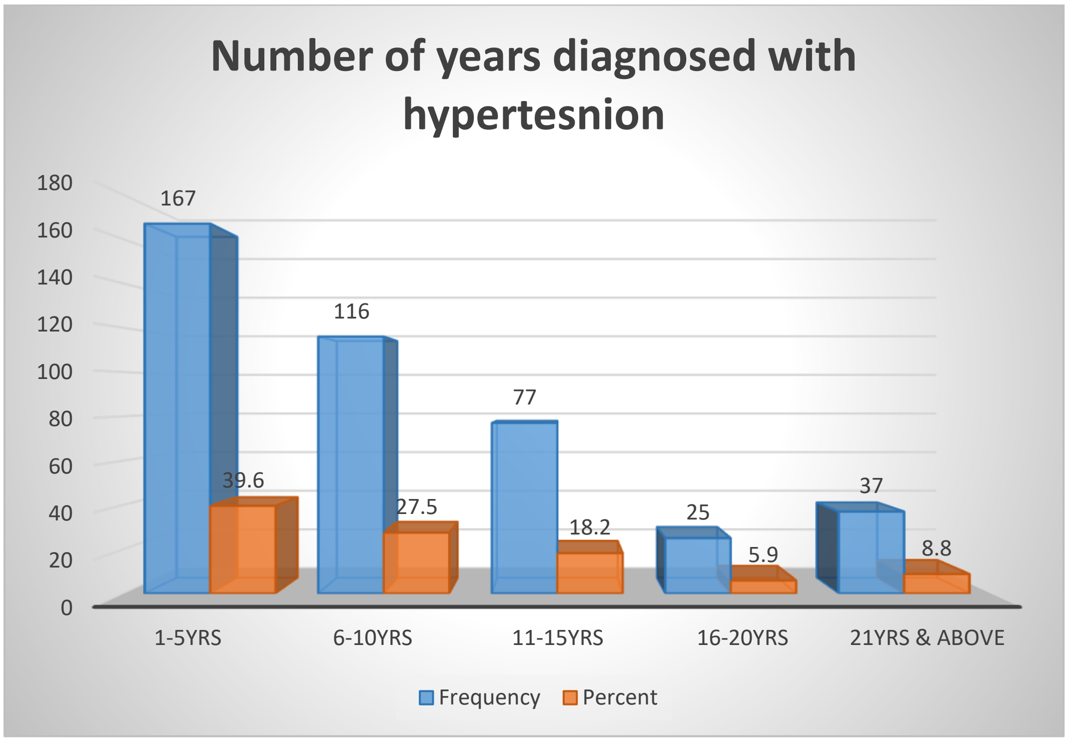

Fig. 4.10 Number of years diagnosed with hypertension

Figure 4.10 above showed the distribution of respondents' years diagnosed with hypertension. The majority of the respondents were diagnosed with hypertension within the last ten years, with those diagnosed within 1 – 5 years having the highest number (n=167; 39.6%) of reported cases, followed by those diagnosed within 6 – 10 years (n=116; 27.5%).

The risk of developing cardiovascular complications in either young or older age patients is substantially conferred by hypertension. More significant risks of adverse outcomes and heritable risk factors can be developed either with early or late onset of hypertension, although the former premise has yet to be demonstrated (Niiranen, Mccabe, Larson, Henglin, Lakdawala, Vasan, and Cheng 2017:1949). This figure's results correlate with the participants' age, where the highest age category of participants with hypertension fell within the age category of 41 and 50 years (Fig. 4.1). Given that hypertension is multifaceted and heterogeneous, it is likely that the less common type of hypertension that develops earlier in life is genetically determined. On the other hand, the environmentally determined type of hypertension could develop later in life. Individuals presenting with high blood pressure in the clinical setting should be screened for heritable factors or, at the onset, be administered, pharmacological agents.

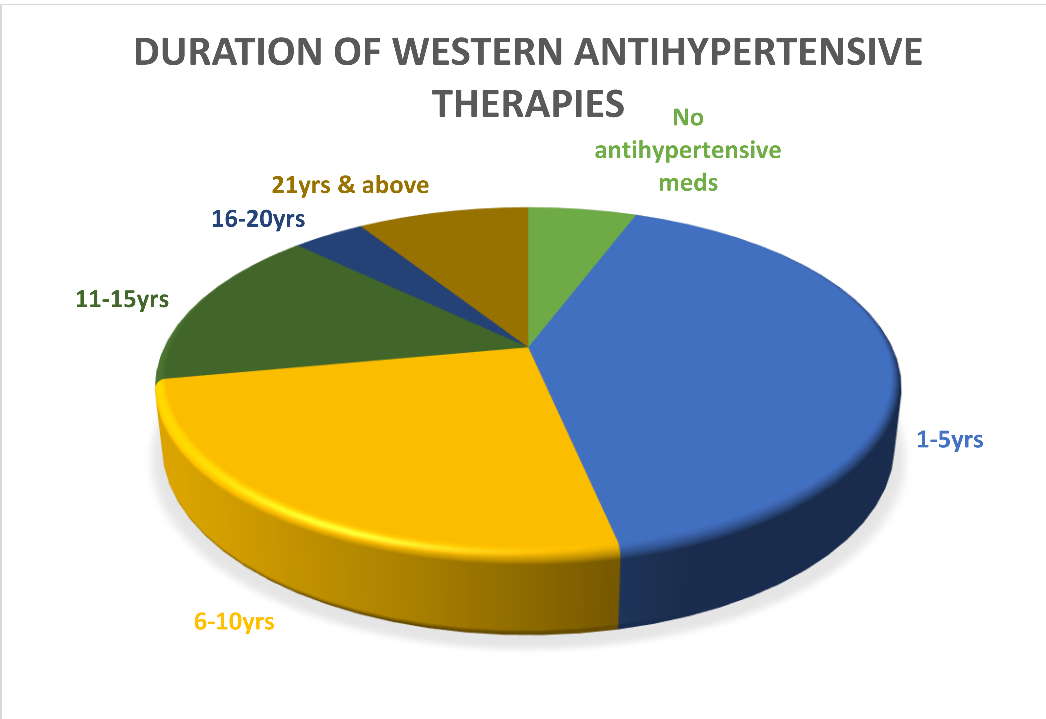

Fig. 4.11 Duration of western antihypertensive therapies

The majority (n=173; 41.0%) of the participants reported being on westerns medications for 1-5 years, while 25.5% (n=107) reported using western medications for 6 – 10years (Fig. 4.11). This result aligns with the data presented in figure 4.10, where most of the respondents were diagnosed with hypertension within 1 – 5 years and 6 – 10 years, respectively. To prevent organ damage in patients diagnosed with hypertension, effective management of hypertension requires the timely clinical provision of balanced nonpharmacological and pharmacologic interventions (Rivera, Martin, and Landry 2019:97).

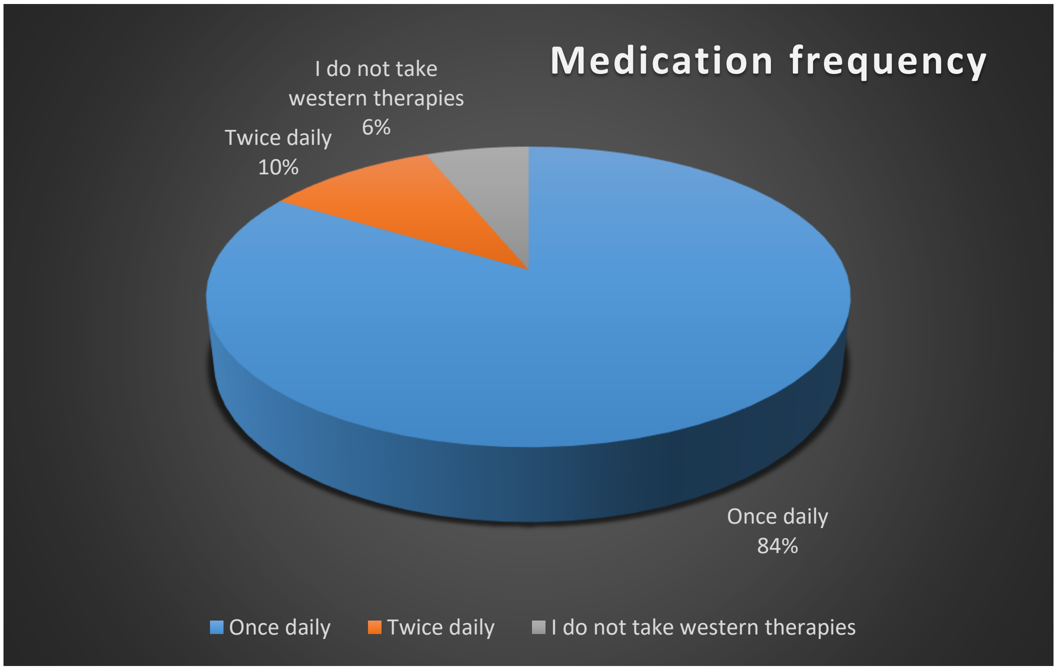

Fig. 4.12 Western medication frequency

The majority (n=353; 83.6%) of the participants took their medications once daily (Fig. 4.12). Reduction in medication consumption has been reported to increase adherence, especially in patients on life-long therapies such as hypertension (Burnier and Egan, 2019:1124). Hypertensive patients who will reach therapeutic goals with their medications were usually those with once-daily single-dose combinations and experienced minimal adverse effects. Being a long-term cardiovascular disease, adherence to hypertensive treatment declined over the years. Adherence to hypertensive medication regimen has been shown to remarkably improve with single-pill once-daily medications or fewer medications (Burnier and Egan 2019:1124). Furthermore, refill frequency consolidation, where a large number of pills are given with each prescription to reduce the number of visits for a refill, aided in compliance with medication utilization among hypertensive patients (Burnier and Egan 2019:1124). The results of this study indicate that most participants adhere to their western antihypertensive medications.

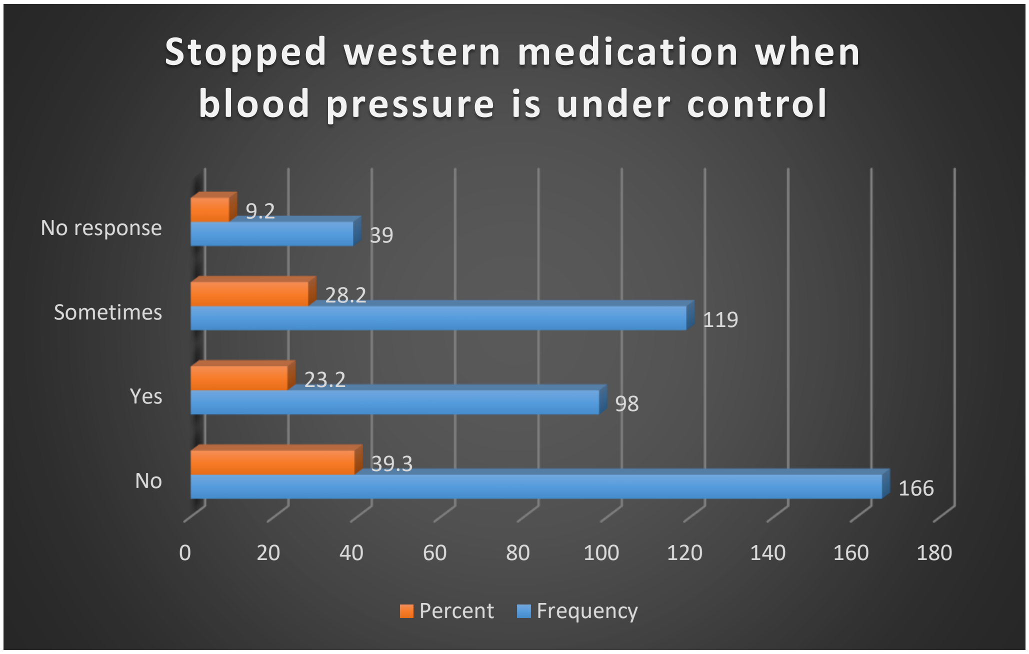

Fig. 4.13. Use of western medications when hypertension is under control.

Participants were asked if they stopped taking their western antihypertensive medications when their blood pressure was under control. The majority (n=166; 39.3%) of the participants reported that they did not stop taking their medications when they felt their blood pressure was under control (Fig. 4.13). The higher rate of adherence seen in this study could be due to the participants' daily single-pill dosing reported in figure 4.12. Effective patient counseling by pharmacists and minimal adverse effects have been reported to improve Western medication adherence (Burnier and Egan, 2019:1124).

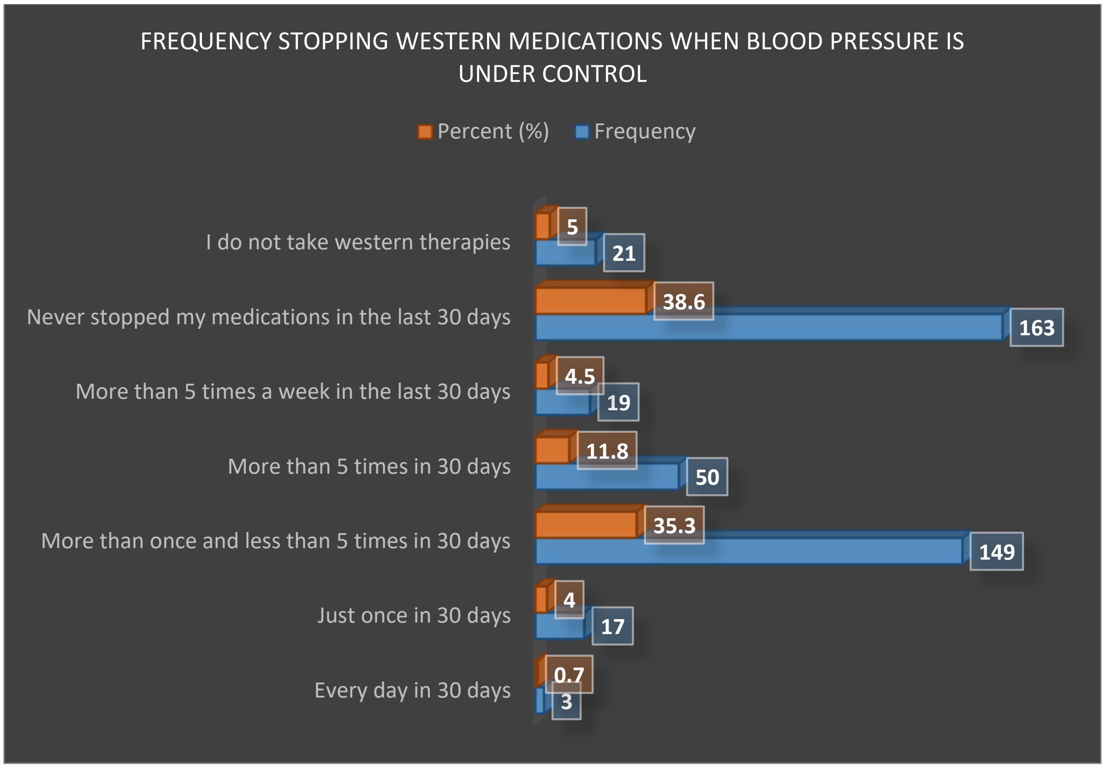

Fig. 4:14 How often respondents stopped taking their antihypertensive medications.

To further establish western medication adherence, participants were asked if they stopped taking their western medications in the last 30 days. The majority (n=163; 38.6%) of the respondents reported near-strict adherence to their western antihypertensive medications, while 35.3% (n=149) reported stopping their western antihypertensive medications more than once and less than five times in 30 days (Fig. 4.14). The key to successful hypertension therapy is the patient's medication adherence. In this study, the majority of participants reported adhering to western medication therapy. Poor adherence to antihypertensive medications has been reported to worsen hypertension with increased hospital admissions and higher risks for cardiovascular emergencies such as stroke accompanying medical burden (Asgedom, Atey, and Desse 2018:27).

Table 4.3. Utilization of Western medication

	Frequency	Percent (%)
Forgot to take western medication		
No	173	41.0
Yes	227	53.8
I do not take western therapies	22	5.2
Total	**422**	**100.0**
Forgetting medications when leaving or during travel.	**Frequency**	**Percent (%)**
No	184	43.6
Yes	217	51.5
I do not take western therapies	21	5.0
Total	**422**	**100.0**
Reduction or stoppage of Western medications without informing doctors.	**Frequency**	**Percent (%)**
No	225	53.3
Yes	74	17.5
Sometimes	102	24.2
I do not take western therapies	21	5.0
Total	**422**	**100.0**
Stressed by adhering to antihypertensive treatment	**Frequency**	**Percent (%)**
No	146	34.6
Yes	159	37.7
Sometimes	96	22.7
I do not take western therapies	21	5.0
Total	**422**	**100.0**

The majority (n=227; 53.8) of the participants reported that they forgot to take their western antihypertensive medications. Participants were also asked, “if they sometimes forget to take along their western antihypertensive medications when they travel or leave home.” The majority (n=217; 51.5%) of the respondents reported that at one time or the other, they forgot to take along their medications when they leave home or travel, while 43.6% (n=184), however, reported otherwise (Table 4.3). Furthermore, participants were asked, “if they are stressed by their adhering to their western antihypertensive medications.” The majority (n=159; 37.7%) admitted that they do, while 22.7% (n=96) reported that they “sometimes” felt stressed by adhering to their western antihypertensive medication regime (Table 4.3).

The results seen in this study are in agreement with similar studies on adherence to Western antihypertensive medications. For instance, the cost of medication, medication side effects, physician-patient relationship, cultural beliefs and lack of social support, low literacy, patient motivation, and failure to remember to take medications are all examples of barriers to medication adherence (Tong, Chu, Fang, Wall, and Ayala 2016:892). Patients missing doses for any reason, being unable to purchase antihypertensive medications because of finances, skipping doses deliberately, and not taking medications as prescribed are some of the reasons why hypertensive patients do not adhere to their medication regimen (Tong et al. 2016:892). Tong et al. (2016:892) further reported that people of low-income, Hispanics, and younger adults were more likely not to adhere to antihypertensive medications than others.

Moreover, data presented in Table 4.3 on forgetting to take Western antihypertensive medications was one of the commonly reported barriers to hypertension therapy (Tong et al. 2016:892). Improving awareness and knowledge of western antihypertensive therapy is, therefore, essential in achieving optimal treatment goals. Strategies to improve patient adherence to Western antihypertensive medications should include selecting an appropriate schedule and time for medication administration. Efforts to improve knowledge should also help patients understand antihypertensive medication’s adverse effects (Tong et al., 2016:892).

Although cardiovascular complications may arise due to hypertension complications, hypertensive patients usually do not present with obvious symptoms. Most patients, therefore, are not knowledgeable about the adverse effects of antihypertensive medications tend to be reluctant to adhere to their regime to avoid adverse effects. The adverse effects and the fact that hypertension does not usually present with symptoms is a sufficient discouraging factor to hamper adherence.

Intervention strategies to improve adherence among patients must, therefore, be adopted based on patient disposition. Simplifying dosing such as one dose per day; face-to-face patient counseling; 90-day prescriptions; special dosing devices; home visits; telephone reminders; a designated family member support system, and home visits have all been reported to be effective strategies that could improve patient's adherence to Western antihypertensive medications (Gebreyohannes, Bhagavathula, Abebe, Tefera, and Abegaz 2019:25; Tong et al. 2016:892).

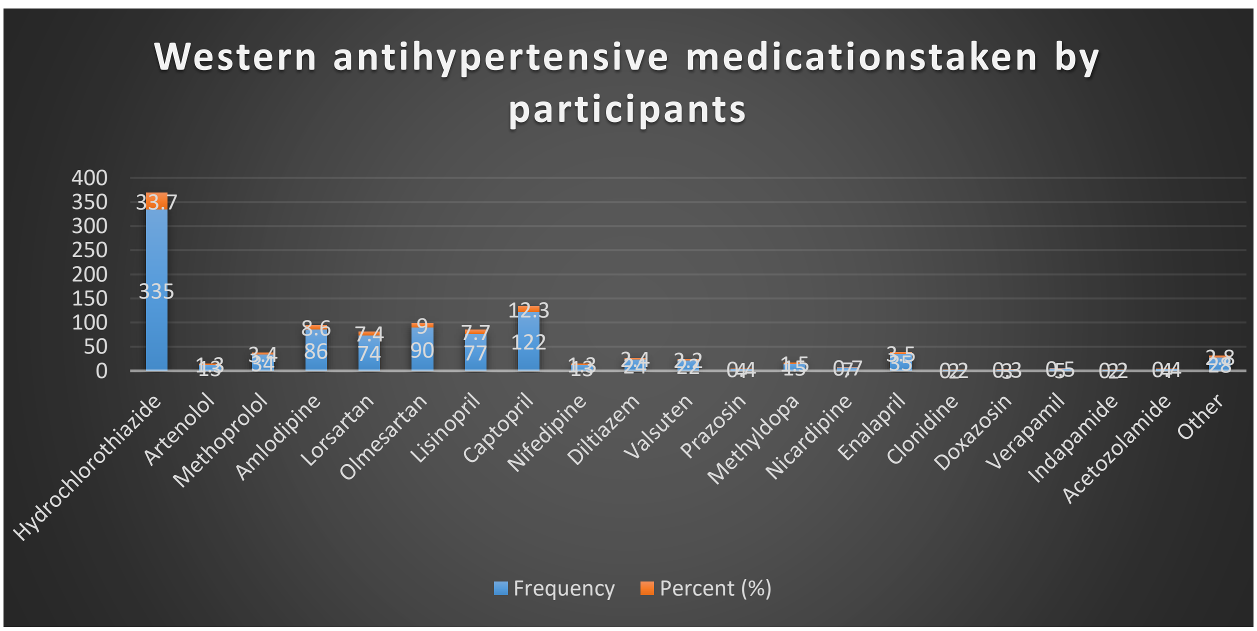

Fig. 4.15 Western therapies used by respondents

Participants were asked to indicate the different types of western antihypertensive medications they are currently taking (Fig. 4.15). The option to select as many medications the participant was taking was made available.

The majority (n=335; 33.7%) of the respondents reported being on hydrochlorothiazide, while 12.3% (n=122) were on captopril. Respondents in this study indicated single, dual, or triple medication usage (Fig. 4.15). There is a universal agreement among clinicians, and some studies have supported combinational antihypertensive therapies to produce better hypertension goals than single therapies (Silva, de Figueiredo, and Rios 2019:3458; Guerrero-García and Rubio-Guerra 2018:212531; Oparil, Acelajado, Bakris, Berlowitz, Cífková, Dominiczak, Grassi, Jordan, Poulter, Rodgers, and Whelton 2018:18014). Typical combinations of antihypertensive medications that are safe and effective in the management of hypertension include a calcium antagonist with a renin-angiotensin system inhibitor (RASI), whether an angiotensin-converting enzyme inhibitor (ACEI) or angiotensin receptor blocker (ARB).

Regardless of whether a free combination or fixed doses type of antihypertensive medications are prescribed to patients, most combinations will include a diuretic. Some studies (Silva et al. 2019:3458; Guerrero-García and Rubio-Guerra (2018: 212531; Oparil et al. 2018:18014) reported universal agreement among clinicians regarding combinational therapies. Greater blood pressure control has always been reported with combinational therapies as compared to monotherapies. Guerrero-García and Rubio-Guerra (2018: 212531) reported that for most antihypertensive patients to reach the recommended goal, a combination of at least two antihypertensive medications should be given. Combination therapies are recommended for patients with a systolic blood pressure reading of about 20mmHg above the target or diastolic pressure 10mmHg above the recommended goal. Aside from providing greater hypertensive control, multiple medications are also recommended in hypertensive patients with risks for cardiovascular complications. Finally, combined therapies reduce the potential for adverse effects while providing superior protection to target organs compared with monotherapy (Guerrero-García and Rubio-Guerra, 2018: 212531). Patients who do not respond to dual therapies within 6-8 weeks will usually require triple therapy with renin-angiotensin system inhibitors, a natriuretic, and a calcium antagonist (Guerrero-García and Rubio-Guerra, 2018: 212531).

4.4 USE OF INDIGENOUS THERAPIES

This section explored the use of indigenous therapies among Belizeans. Respondents were asked about indigenous therapy usage in treating hypertension (HTN) or other diseases, parts of plants used for therapies, sources of therapies, and methods used to prepare indigenous therapies.

Table 4.4 knowledge and usage of indigenous therapies.

Knew about indigenous therapies for HTN	**Frequency**	**Percent (%)**
No	61	14.5
Yes	361	85.5
Total	**422**	**100.0**
Use of indigenous therapies to treat other diseases	**Frequency**	**Percentage (%)**
No	95	22.5
Yes	197	46.7
Sometimes	130	30.8
Total	**422**	**100.0**
Knew someone using indigenous therapies for HTN	**Frequency**	**Percentage (%)**
No	86	20.4
Yes	336	79.6
Total	**422**	**100.0**
Use of indigenous therapies to treat HTN	**Frequency**	**Percentage (%)**
No	190	45.0
Yes	161	38.2
Sometimes	71	16.8
Total	**422**	**100.0**

Table 4.4 above presents respondents' knowledge and use of indigenous therapies. 85.5% (n=361) of participants reported that they are knowledgeable of indigenous therapies for HTN, 46.7% (n=197) reported they use indigenous therapies to treat other diseases, while 30.8% (n=130) "sometimes" use indigenous therapies to treat other diseases apart from hypertension. Whereas 79.6% (n=336) reported that they knew about indigenous therapies for hypertension, about 45% (n=190) did not use indigenous therapies to manage their hypertension. About 38.2% (n=38.2) reported using indigenous therapies for HTN, while 16.8% (n=71) used indigenous therapies sometimes.

Ever before the emergence of modern medicines, people have used indigenous therapies to treat their diseases. Presently, over a hundred active compounds have been scientifically identified as drugs from plants alone (Helmenstine 2019:1). An increasing amount of literature exists on medicinal plants and herbs used for the management of hypertension. Some of the herbal therapies have gone through extensive studies with many reported discoveries about their bioactive metabolites, while others are still being studied, and new information on their pharmacology and toxicities has been revealed (Helmenstine 2019:1). This study is in agreement with globally presented research on the use of indigenous therapies in many communities.

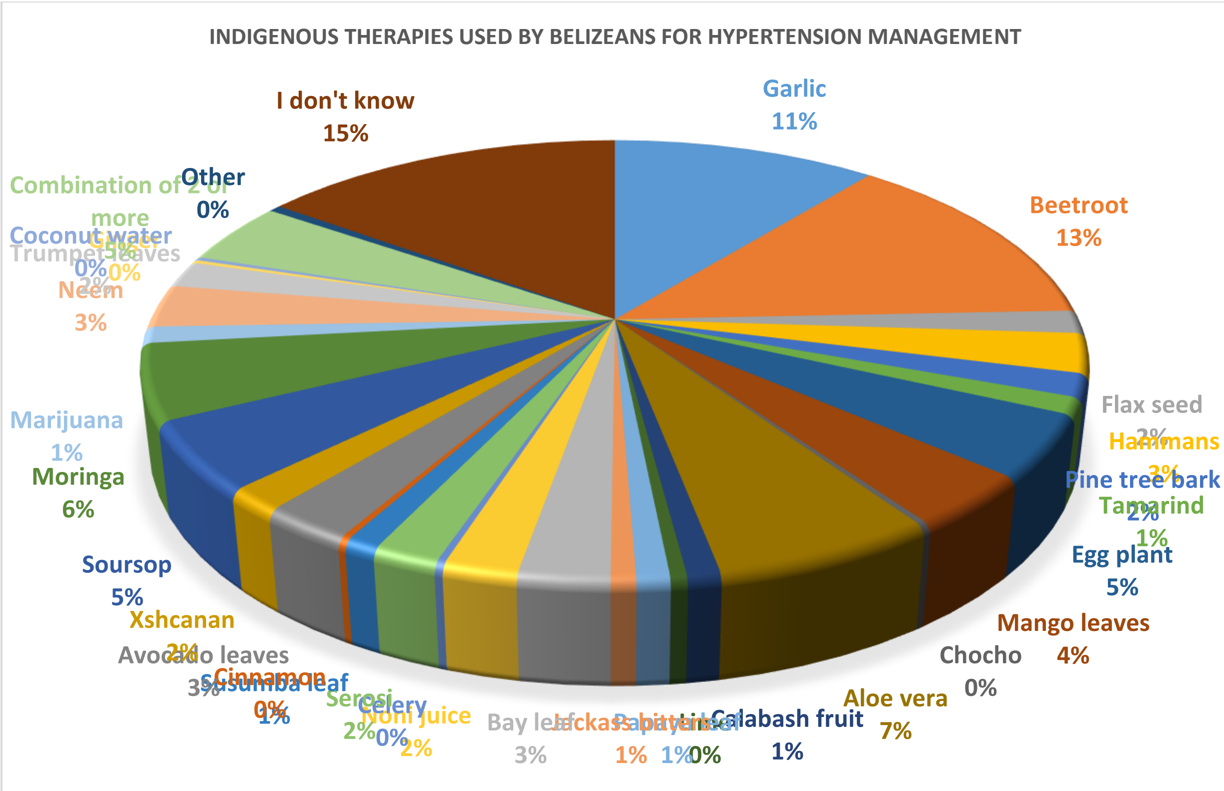

Fig. 4.16 Indigenous therapies used by Belizeans for hypertension management

Respondents were asked the indigenous therapies they knew about the management of hypertension in Belize. Over 30 different plants were mentioned as indigenous therapies used for the management of hypertension in Belize. Beetroot (n=56; 13.3%), garlic (n=45; 10.7%), and aloe vera (n=27; 6.4%) were among the highest reported indigenous therapies used for the management of hypertension (Fig. 4.16).

Beetroot juice was reported to be the most indigenous antihypertensive therapy consumed by hypertensive clients in this study. Nitrate-dietary supplementation with beetroot juice has been advanced as a nutritional approach for controlling arterial blood pressure in healthy clients, pre-hypertensive subjects, and already diagnosed patients managed with Western antihypertensive medications (Bonilla et al. 2018:134). Secondary metabolites found in *Beta vulgaris* juice probably utilizes the nitrate/nitrite/nitric oxide (NO_3^-/NO_2^-/NO) pathway has been reported to be a cost-effective approach to reducing blood pressure in several hypertensive populations.

Reduction in morbidity and mortality from hypertension complications could be significantly reduced by using beetroot juice as a cheap and easily accessible diet to manage cardiovascular complications. The use of beetroot juice in populations at risk of developing hypertension and those already diagnosed with hypertension should practice a healthy nutritional lifestyle to control hypertension. In order to have sustained and significant blood reduction with beetroot, it is recommended that a minimum of 2 weeks of administration be adopted (Bonilla, Paipilla, Marín, Vargas-Molina, Petro, and Pérez-Idárraga 2018:134). Therefore, this study's results need to be further explored in the use of beetroot to manage hypertension.

Table 4.5 Rational for indigenous therapies usage for hypertension.

Rationale for taking indigenous therapies for hypertension.	**Frequency**	**Percent (%)**
Safe	27	6.4
Cheap	30	7.1
Available	35	8.3
Religion	16	3.8
Natural	173	41.0
Effective	43	10.2
Chose all options	18	4.3
Combination of 2 or more	23	5.5
I do not know	57	13.5
Total	**422**	**100.0**
Rationale for not taking indigenous therapies to treat hypertension.	**Frequency**	**Percent (%)**
Not safe	51	12.1
Interactions	53	12.6
Doctors/health professional advice	13	3.1
No reason	114	27.0
Herbs and medications do not work together	48	11.4
No response	115	27.3
Other	26	6.2
I do not take indigenous therapies for HTN	2	.5
Total	**422**	**100.0**

Respondents were asked reasons “why they take or do not take indigenous therapies to treat their hypertension.” The majority (n=173; 41%) of respondents attributed using indigenous therapies to the simple reason that they were natural (Table 4.5). The “no response” (n=115; 27.3%) and “no reason” (n=114; 27%) formed the highest reported rationales for not consuming indigenous therapies for hypertension, respectively.

The high figures seen as a rationale for not taking indigenous antihypertensive therapies could probably be attributed to respondents who did not use indigenous therapies to manage hypertension.

Numerous factors have led to a substantial global increase in medicinal plant usage. Foremost among them is that indigenous therapies are inexpensive compared to conventional drugs and have fewer adverse effects. The World Health Organization (2014:8) reported that this increase in patronizing herbal remedies is not necessarily dependent on the country, region or economic status or the individuals since complementary and alternative medicines are now used by over 70% of people in developed countries for the prevention or treatment of various ailments and diseases. The trend is not any less in developing countries where a more pronounced usage of alternative medicines is being recorded (WHO 2014:8; Ekor 2014:177).

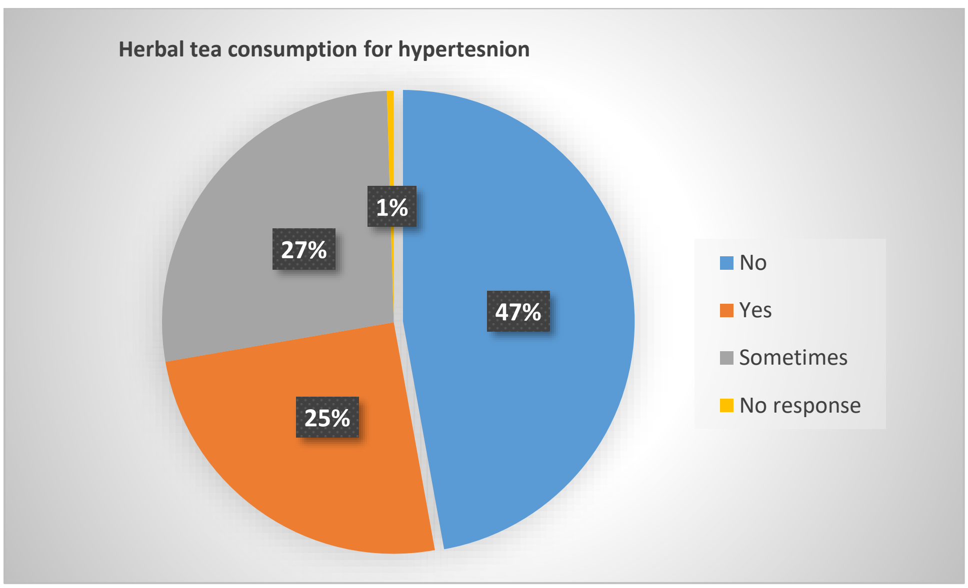

Figure 4.17 Herbal tea consumption

The majority of the respondents reported using herbal teas regularly (n=106; 25.1%) or sometimes (n=115; 27.3%) for the management of their hypertension (Fig. 4.17). 47.2% (n=199) of respondents reported they do not take herbal teas for their hypertension.

The use of teas, especially Camellia *sinensis* (green tea), has been reported by many scientists in many disease conditions. Green tea has been reported to be the most frequently consumed beverage worldwide (Faria et al. 2012:1838; Peng et al. 2014:6251). Different researchers have presented conflicting reports on the antihypertensive effect of C. sinensis. For instance, earlier reported data (Hodgson et al. 1999:457; Hodgson et al. 2002:195; Peng et al. 2014:6251) showed an increase in blood pressure after 30 min of C. sinensis consumption with a return to baseline readings after 60 minutes. Nagao et al. (2007:1473), however, reported a decrease in systolic blood pressure in patients with 140mmHg or higher values. Meta-analysis studies also showed varying levels of blood pressure effects among participants given C.*sinensis* (Peng et al. 2014:6251). Taubert et al. (2007:626) reported no change in blood after drinking C. *sinensis* in a meta-analysis of five trials. However, Peng et al. (2014:6251) demonstrated a reduction in both systolic (1.98mmHg) and diastolic (1.92mmHg) blood pressure in a meta-analysis study of randomized controlled trials. Other studies tend to agree with a reduction in both systolic and reduce blood pressure due to C.*sinensis* consumption (Bogdanski et al. 2012:421; Hodgson et al. 2012:186). Compared with black tea, green tea induced a more potent antihypertensive effect, especially with long-term consumption (Al Disi et al. 2016:323).

Furthermore, different catechins have been described as the major flavonoids found in green tea. Deka and Vita (2011:136) reported epicatechin (EC), epicatechin-3-gallate (ECG), epigallocatechin (EGC), and epigallocatechin-3-gallate (EGCG) as the significant catechins found in green tea. The primary catechins predominant in green tea were EGCG (Babu and Liu, 2008:1840; Faria et al. 2012:1838; Slevin et al. 2012:1186; Thomson et al. 2012: 409047). In addition, vasorelaxant effects have long been reported as responses to flavonoids. Ras et al. (2011: e16974) reported flow-mediated dilation, while Oyama et al. (2010:578) reported endothelial-dependent dilation.

Catechins are converted by an enzymatic (polyphenol oxidase and peroxidase) oxidative polymerization reaction to tannins: the aflavins (benztropolone ring) and arubigins, both of which are orange-red colored polyphenolic pigments that are also potent vasodilators (Yang et al. 2011: 397136).

The risks of hypertension are significantly reduced by green tea via attenuating oxidative stress. Through some mechanisms such as inhibition of eNOS uncoupling (Faria et al. 2012:1838), an increase of CAT antioxidant enzymes while simultaneously blocking AT1 receptors in streptozotocin-treated rats (Thomson et al. 2012: 409047), upregulate the expression of antioxidant genes such as SOD1 and GST in C57BL/6 mice (Newsome et al. 2014:126), and scavenging superoxides (Nakagawa and Yokozawa, 2002:1745) in vitro as well as to attenuate NAPDH oxidase production (Ribaldo et al. 2009:96) in people with diabetes.

With over 50% of participants reporting using herbal teas to manage their hypertension, this figure calls for further investigation to identify the type of teas being used, frequency, duration, and concomitant use with western antihypertensive therapies. There is a need to investigate the efficacy of herbal teas for the management of hypertension in Belize.

Table 4.6 Indigenous therapies used by respondents to manage their hypertension

Indigenous therapies used by respondents to manage hypertension.	**Responses**		
	Frequency	**Percent (%)**	**Percent of cases (%)**
Garlic (*Allium Sativum*)	227	19.4	70.9
Lime (*Citrus aurantiifolia*)	105	9.0	32.8
Aloe Vera (*Aloe barbadensis miller*)	78	6.7	24.4
Soursop (*Annona muricata Linnaeus*)	72	6.2	22.5
Celery (*Apium graveolens*)	72	6.2	22.5
Beetroots (*Beta vulgaris*)	71	6.1	22.2
Lettuce (*Lactuca sativa*)	51	4.4	15.9
Sorrel (*Hibiscus sabdariffa*)	45	3.9	14.1
Eggplant (*Solanum Molongena*)	45	3.9	14.1
Trumpet Tree (*Cecropia peltata*)	43	3.7	13.4
Moringa (*Moringa oleifera*)	40	3.4	12.5

Cerocee (*Momondica charantia*)	30	2.6	9.4
Jackass Bitter (*Neurolaena lobata*)	27	2.3	8.4
Almond/hammon (*Termialia catapp*)	27	2.3	8.4
Choko (*Sechium edule*)	25	2.1	7.8
Lemongrass (*Cymbopogon citratus*)	24	2.1	7.5
Avocado leaves (*Persea americana*)	23	2.0	7.2
Susumba (*Solanum Turvum*)	15	1.3	4.7
Noni (*Morinda citrifolia*)	15	1.3	4.7
Bay Leaves (*Laurus nobilis*)	14	1.2	4.4
Calabash Tree (*Crescentia cujeta*)	14	1.2	4.4
Neem (*Azadirachta indica*)	13	1.1	4.1
Wild Tamarind/Jumbie plant (*Tamarindus Indica*)	11	0.9	3.4
Periwinkle/ Ram goat (*Catharanthus roseus*)	11	0.9	3.4
Cat's claw (*Uncaria tomentosa/ U. guianensis*)	11	0.9	3.4
Cascarilla (*Croton eluteria*)	9	0.8	2.8
Scoggineal (*Opuntia cochenillifera*)	9	0.8	2.8
Pine bark (*Pinus*)	9	0.8	2.8
Mango (*Mangifera indica*)	8	0.7	2.5
Guava (*Psidium guajava*)	8	0.7	2.5
Papaya (*Carica papaya*)	7	0.6	2.2
Breadfruit (*Artocarpus Altillis*)	7	0.6	2.2
Chestnut (*Pachina aquatica*)	2	0.2	0.6

Respondents were asked to choose single or multiple/combinational indigenous therapies they used to manage their hypertension. Over 30 indigenous therapies used to manage hypertension were reported by the respondents (Table 4.6). Respondents also reported Garlic (*Allium sativum*) 70.9% of cases (n=225); Lime (*Citrus aurantiifolia*) 32.8% of cases (n=105), while aloe vera (*Aloe barbadensis miller*), 24.4% of cases representing a frequency of 78 as the most common indigenous therapies used for the management of hypertension.

The high response seen with garlic in this study is in line with many reported health benefits of garlic, especially its use in managing hypertension. For instance, garlic has been reported for its anti-inflammatory, hypocholesterolemic, anti-cancer, antibacterial, hypotensive, and antioxidant properties, and its healing abilities have been reported in various cultures and societies for over a thousand years (Chan et al. 2020:1). Furthermore, in many developed and developing countries, physicians and clinical researchers are continuing in their efforts to investigate the numerous claims made regarding the multi-fold healing powers of garlic (Qidwai and Ashfaq, 2013:12; Chan et al. 2020:1). In line with some of these claims, Ried et al. (2013:16) reported that individuals using garlic for medicinal purposes or spices consume either the extract, powder, oil, or raw form. The pungent smell of garlic limits raw consumption in some individuals; hence, many enteric-coated supplements that dissolve easily in the gastrointestinal tract are available for ease of consumption (Chan et al. 2020:1). Reports by, Qidwai and Ashfaq (2013:12) and Chan et al. 2020:1) indicated that the number of people treating their hypertension with garlic is much, and interest in its use is rising. The main bioactive organo-sulfur substances reported in garlic are diallyl disulfides (DADS), methyl thiosulfonate, S-allyl cysteine (SAC), diallyl trisulfides (DATS) and Allicin (Qidwai and Ashfaq, 2013:12), produce unique mechanisms of action. Although garlic is presented to be potentially useful in many health situations, and its use has found global acceptance, numerous pharmacologic mechanisms of action for hypotension have been reported (Shouk et al. 2014:15) based on the constituents identified.

For instance, the reduction in systolic blood pressure or diastolic blood pressure only has been reported in some studies, while no change in blood pressure or significant lowering of blood pressure was reported in other studies (Augusti et al. 2012:7; Oga et al. 2015:24; Chan et al. 2020:1). Despite the irregular reported effects of garlic and its constituents, the induction of its hypotensive abilities has been confirmed in many studies (Chan et al. 2020:1). Various garlic types have been reported to lower systolic, diastolic, or both blood pressure in an extensive review (Barnerjee et al. 2002:1509). In the same vein, garlic was reported (Qidwai and Ashfaq 2013:12; Chan et al. 2020:1) to have an efficacy of almost 80% as an antihypertensive herb.

Finally, garlic's antihypertensive properties have been reported to be mediated by endogenous signaling gases such as nitric oxide and hydrogen sulfide (Banerjee et al. 2002:1509; Mousa and Mousa 2007:119; Ried et al. 2013:4; Chan et al. 2020:1), where a significant decrease of 17mmHg in SBP was reported in stage I hypertensive patients administered 2600mg of garlic for ten days (Mousa and Mousa 2007:119). Interestingly, Garlic extracts have also been shown to increase the bioavailability of nitric oxide by 200% (Mousa and Mousa 2007:119), increased hydrogen sulfide production and induces its synthesis for vasorelaxant activity (Benavides et al. 2007:3), increased expression of Connexin-43 (Cx43), a gap junction protein correlated with a reduced VSMC proliferation and DNA synthesis (Joshi et al. 2012:220), and inhibition of ACE (Sendl et al. 1992:3). Inhibition of vascular smooth muscle cell proliferation, reduction in angiotensin II-induced vasoconstrictor responses, abrogation of the activation of NF-κB, and inhibition of endothelin-1 induced vasoconstriction have all been reported with garlic (Banerjee et al. 2002:1509; Castro et al. 2010:552; Pan et al. 2012: 627375). Therefore, the current study results agree with previously reported data on garlic's use to manage hypertension.

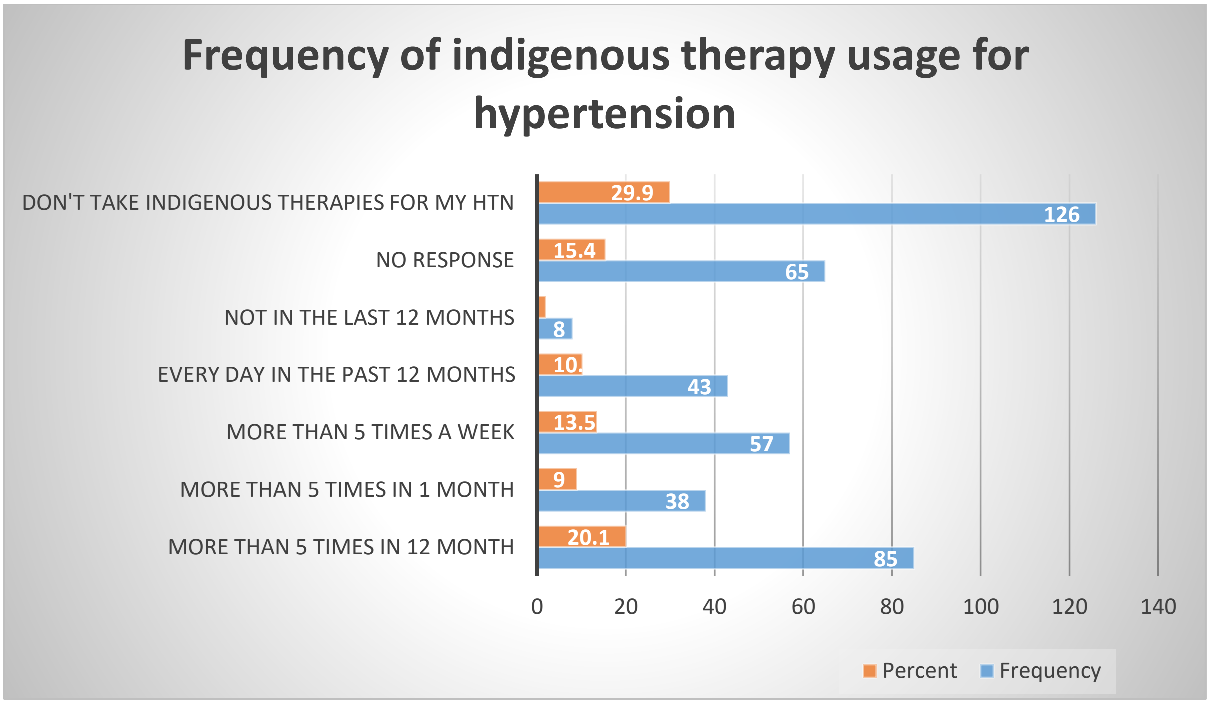

Figure 4.18 Frequency of indigenous therapy usage for hypertension

Survey respondents were asked how often in the last 12 months, they used indigenous therapies to manage their hypertension. Approximately 20.1% (n=85) reported having consumed indigenous therapy for their hypertension more than five times in 12 months. 13.5% (n=57) reported consuming the therapies more than five times in a week, while 10.2% (n=43) reported taking indigenous therapies for their hypertension every day in the past 12months (Fig. 4.18). These results suggest that participants are involved in the active consumption of indigenous therapies to manage their hypertension, even though they are also on western antihypertensive medications.

Table 4.7 Combined indigenous and western therapies for hypertension

Combined indigenous therapy with western medicines for hypertension	Frequency	Percent (%)
Indigenous therapies alone	83	19.7
Indigenous therapies and western medications together	26	6.2
Sometimes indigenous therapies alone and sometimes in combination with western therapies.	98	23.2
Western therapies alone	13	3.1
I do not take indigenous therapies for HTN	202	47.9
Total	422	100.0
Rationale for combining indigenous therapies with western medicines	Frequency	Percent (%)
Combination of the 2 is effective	119	28.3
Medicines alone not effective	17	4.0
Medicines are expensive	9	2.1
Medications have many side effects	7	1.7
No harm in taking both together	44	10.4
Combination of 2 or more responses	22	5.2
I do not take indigenous therapies for HTN	204	48.3
Total	422	100.0
Combining indigenous and western therapies help lower blood pressure	Frequency	Percent (%)
No response	9	2.1
No	62	14.7
Yes	71	16.8
Sometimes	93	22.0
I do not know	74	17.5

I do not take indigenous therapies for HTN	113	26.8
Total	422	100.0
Awareness of probable interactions	Frequency	Percentage
No response	33	7.8
No	106	25.1
Yes	153	36.3
I do not know	38	9.0
I do not take indigenous therapies for HTN	92	21.8
Total	422	100.0

Respondents were asked if they consumed indigenous therapies combined with Western medicines, and if the combination was effective in lowering elevated blood pressure. Only 6.2% (n=26) reported consuming indigenous therapies with western medications (Table 4.7). However, 23.2% (n=98) reported that they sometimes take indigenous therapies alone and sometimes in combination with Western therapies. The majority (n=119; 28.3%) of the respondents also reported that the combination of indigenous-western medications used to manage hypertension is effective. 10.4% (n=44) opined that there is no harm in combining indigenous therapies with Western medications, while 22% (n=93) and 16.8% (n=71) reported "sometimes and "yes" respectively, to how effective combining indigenous and Western therapies lower blood pressure. Conversely, 36.3% (n=153) reported being aware of probable interactions when indigenous and western therapies were taken together. 25.1% (n=106) were unaware of possible interactions when indigenous and Western therapies were consumed together (Table 4.7).

A common practice with indigenous therapy is polypharmacy. Polypharmacy is the use of more than one drug or substance for therapy (Dookeeram et al. 2017:1119; Burt et al. 2018:2). This practice is monitored in the clinical setting using carefully designed paper-based or computer software.

Although it is much easier to monitor the possibilities of drug-drug interactions in the clinical setting, monitoring for indigenous-western drug interactions is difficult because these interactions have not been scientifically extensively studied. There are many uncharacterized compounds in medicinal plants that present many opportunities for drug-herb or herb-herb interactions. These drug-herb or herb–herb interactions can precipitate toxic effects or, in some instances, render the therapeutic effect of a conventional drug or the more promising herbal preparation (Mphuthi 2015:203; Kahraman, Arituluk, and Cankaya 2020). The concomitant use of indigenous therapies with Western antihypertensive medications seen in this study calls for further investigation and monitoring.

It has been reported that dependence on indigenous medicines and medicinal plants has increased significantly by about 80% in many developing countries. In many developing nations, indigenous medicines and herbal therapies are mainly a substantial primary health care source. Herbal therapies are currently not only utilized by developing countries; instead, the trend has shown a global increase in awareness and usage of the products (Mahady 2011:120S; WHO 2019:1). For instance, according to reports, there is presently an active reliance on natural and complementary therapies to prevent or manage many ailments in Germany, where over 75% of the population use natural products (Tuffs 2002:990). The report further indicated that 70% of the country's physicians prescribe traditional herbal medicines to their patients for diverse ailments (Tuffs 2002:990).

In many communities where indigenous therapies are used, the general belief is that they are safer than Western medications because they are obtained from natural sources and have fewer side effects. However, several studies have debunked this perception and showed that interactions do occur between herbs and western medications and that such interactions could be harmful, ranging from mere side effects to more serious adverse reactions. For instance, St. John's wort (*H. perforatum L.*) has been reported to increase warfarin metabolism, initiating a reduction in warfarin's anticoagulant effect at the same time leading to an increases digoxin renal excretion (Kahraman et al. 2020).

Ginkgo (*Ginkgo biloba L.*) has been reported to potentiate the aspirin's antiplatelet effect, while garlic *(Allium sativum* L.) has a blood-thinning effect when taken concurrently with warfarin. Green tea (*Camellia sinensis L.*), on the other hand, antagonizes the anticoagulant effect of warfarin, while reduction of digoxin absorption has been reported when concomitantly taken with guar gum (*Cyamopsis tetragonoloba Taub.*).Therefore, these available scientific reports provide evidence that interactions exist between indigenous therapies and Western therapies, especially those used to manage cardiovascular events (Bonilla et al., 2018:134; Kahraman et al., 2020).

Table 4.8 informed doctor/medical practitioner of indigenous therapy use for hypertension.

Doctor informed of indigenous therapy usage	Frequency	Percent (%)
No response	65	15.4
No	149	35.3
Yes	50	11.8
I do not take indigenous therapies for HTN	158	37.4
Total	**422**	**100.0**
Rationale for not informing doctor of indigenous therapy usage	**Frequency**	**Percent (%)**
No response	96	22.7
Did not think it was important	18	4.3
I was not asked	18	4.3
Was not aware that I should inform him/her	7	1.7
Doctors do not like indigenous therapies	4	.9
Did not want doctor to stop me	3	.7
No reason	90	21.3
I do not take indigenous therapies for HTN	186	44.1
Total	**422**	**100.0**

The majority (n=149; 35.3%) of respondents reported not informing their medical practitioners about using indigenous therapy to manage their hypertension, and 21.3% (n=90) did not give a reason for not informing their medical practitioners about indigenous therapy consumption for the management of their hypertension. 4.3% (n=18) reported that they did not think it was necessary to report indigenous therapy usage to their medical practitioners. At the same time, the same percentage of respondents also reported that their medical practitioners did not ask them about their use of indigenous therapies for the management of their hypertension (Table 4.8).

Although the use of herbal therapies is rising in many countries and approval for their usage is gaining wide acceptance, the story is different in other countries where rigorous regulative obligations make it challenging and difficult for herbal medications to be registered. Therefore, the stringent regulatory requirements in such countries limit the opportunity for the use of medicinal herbs. For instance, herbal medicines in the United Kingdom have been viewed with reservation and seen suspiciously as therapies that are likely to cause peculiar health challenges to the public's general health. Because of this perception, many consultations between indigenous medicine practitioners and physicians are being conducted to ensure public safety while being careful not to deny the benefits derived from such products (Walker 2015:1; Boyle et al. 2011:951).

The concurrent use of conventional and indigenous therapies for treating high blood pressure, including other non-communicable diseases such as diabetes, is a global phenomenon. For example, earlier research reports among diagnosed hypertensive clients in Palestine (Ali-shtayeh and Jamous 2013:256) showed that 85.7% of 4575 had concomitantly been taking western prescription antihypertensive medicines alongside herbal therapies. In a similar study in India, Shafiq, Gupta, Kumari, and Pandhi (2003:294) reported that both herbal remedies and western prescribed medications were concurrently consumed by approximately 63.9% of hypertensive study participants. In both studies, the study participants did not reveal to their health practitioners the use of indigenous therapies to manage their hypertension. Additionally, the respondents did not believe that the indigenous therapies they consumed were relevant to their hypertensive management since they were not asked by their healthcare providers (Bonilla et al., 2018:134). The responses seen in this study agree with those of previous studies.

Table 4.9 Sources and parts of indigenous therapies

Sources of indigenous therapies	**Frequency**	**Percent (%)**
Grocery store	13	3.1
Bush doctor/vendor/market	69	16.3
Herbal store	11	2.6
Yard/Family/friends/	94	22.3
Combination of 2 or more responses	49	11.6
I do not take indigenous therapies for HTN	186	44.1
Total	**422**	**100.0**
Parts of indigenous therapies used for hypertension management	**Frequency**	**Percent (%)**
Leaves	64	15.2
Roots	3	.7
Seeds	1	.2
Fruit	3	.7
Combination of leaves, roots, seeds, or bark.)	161	38.2
I do not take indigenous therapies for HTN	190	45.0
Total	**422**	**100.0**

The primary sources of indigenous therapies reported by respondents were yard/family/friends (n=94; 22.3%) and indigenous therapy vendors/markets (n=69; 16.3%). Leaves (n=64; 15.2%), or a combination of leaves, roots, seeds, or bark (n=161; 38.2%), were majorly reported as the parts used for hypertension therapy (Table 4.9).

The search for new drugs, especially from indigenous sources, has continued to heighten in recent years, and global interest is daily developing, with research being conducted to unravel the active ingredients and efficacy of indigenous therapies. Belize has a rich rain forest that is important for searching for new medicines for cardiovascular management. Especially for the management of cardiovascular diseases. So far, not much has been studied to discover the vast potential of medicinal plants in Belize. Plants from rain forests can be sources of new drugs that have the potential for fewer side effects and may have greater bioavailability for the management of hypertension and other non-communicable diseases. As it were, Belize is a considerable source of indigenous therapies that is yet untapped.

Table 4.10 preparation and consumption of indigenous therapies

Indigenous therapies preparations	**Frequency**	**Percent**
No response	3	.7
Infusions (hot teas)	72	17.1
Decoctions (boiled teas)	11	2.6
Tinctures (alcohol and water extracts)	9	2.1
Macerations (cold-soaking)	4	.9
Blend with water	11	2.6
Soaking	12	2.8
Eat/chew raw	5	1.2
Combination	98	23.2
Prepared: Capsules/teas/powders etc.	6	1.4
I do not take indigenous therapies for HTN	191	45.3

Total	**422**	**100.0**
How indigenous therapies are taken	**Frequency**	**Percent (%)**
Drinking	122	28.9
Combination of 2 or more	84	19.9
With food (add to food)	25	5.9
I do not take indigenous therapies for HTN	191	45.3
Total	**422**	**100.0**
Single or combined indigenous therapies	**Frequency**	**Percent (%)**
No response	12	2.8
Single	40	9.5
Combination	66	15.6
Sometimes single and sometimes a combination	113	26.8
I do not take indigenous therapies for HTN	191	45.3
Total	**422**	**100.0**

Infusions or hot teas (n=72; 17.1%) and a combination of preparations (n=98; 23.2) are the most commonly used methods for preparing indigenous therapies, as reported by respondents. Drinking (n=122; 28.9%) indigenous therapy was the commonest route of administration in addition to the reported combination (n=84; 19.9%) of one or more routes (Table 4.10). Respondents also reported that they consume indigenous therapies "sometimes single and other times in combination" (n=113; 26.8%), in combination (n=66; 15.6%) or as a single therapy (n=40; 9.5%).

The clinical efficacy of indigenous therapies is affected by some factors. These include extraction methods such as water decoction, accurate diagnosis of the disease condition by untrained personal, accurate prescriptions, and the dosage of the indigenous therapy inclusive of the administration method are few such factors. However, the most restricting factor in the use of indigenous therapies is the dosage. The dosage of indigenous therapies has, for the most part, been challenging to study because it can be influenced by extraction methods, the production area, the effective fraction of the indigenous therapy, and the formulation of the preparation. Additionally, this becomes more complicated if more than one formulation is required to prepare the therapy (Wet, Ramulondi, and Ngcobo 2016:78).

The results of this study indicated that more than 42% (n=179) of the participants were involved in combining one or more herbs in the formulation of indigenous therapies to manage hypertension. With the difficulty of ascertaining the dosages of indigenous therapies, the lack of adequate knowledge of active ingredients by those involved in indigenous therapies, and the lack of knowledge on disease conditions, using multiple ingredients to formulate indigenous therapies for hypertension may complicate hypertension management among participants.

Table 4.11 Indigenous therapies use and rationale for the use.

Indigenous therapies better than western medicines	**Frequency**	**Percent**
No response	2	.5
No	19	4.5
Yes	44	10.4
Both are effective	56	13.3
Sometimes western medicine is better	30	7.1
Sometimes herbs are better	55	13.0
I do not know	24	5.7
I do not take indigenous therapies for HTN	190	45.0
Other	2	.5

Total	**422**	**100.0**
Rationale for preferring indigenous therapies to western medicines	**Frequency**	**Percent (%)**
No response	11	2.6
Western therapies are expensive	7	1.7
Hospitals waste too much time	18	4.3
Indigenous therapies are natural	76	18.0
Indigenous therapies are available	23	5.5
Indigenous therapies are safe	35	8.3
I do not like doctors/nurses.	3	.7
Combination of 2 or more responses	23	5.5
I do not prefer indigenous to western therapies	16	3.8
Indigenous therapies are effective	60	14.2
Other	10	2.4
I do not take indigenous therapies for my HTN	140	33.2
Total	**422**	**100.0**

Participants were asked if they considered indigenous therapies better than Western therapies in the management of hypertension. Varying responses were obtained from respondents (Table 4.11). For instance, 13% (n=56) of the respondents reported “sometimes herbs are better,” while 10.4% (n=44) indicated that they considered indigenous therapies better than Western therapies (Table 4.11). On the other hand, 13.3% (n=56) reported that indigenous and Western therapies effectively manage hypertension. Furthermore, respondents were asked why they preferred indigenous therapies better than Western therapies in managing hypertension. Approximately 18% (n=76) of the respondents reported that they use indigenous therapies because they are natural, while 14.2% (n=60) indicated that they use indigenous therapies because of their effectiveness.

The global increase in the awareness of indigenous therapies, especially herbs, is perceived to be safe and efficacious simply because they are from natural sources coupled with the long ancestral history of linkage to African folklore beliefs and practices (Mphuthi 2015:212; Mans et al. 2017b:1), has led to people consuming indigenous remedies. In Belize, for instance, it is a common practice for people to try indigenous remedies before coming to the hospital or combining indigenous remedies with Western medications.

Beneficial effects could also be experienced by the use of indigenous therapies, especially among hypertensive patients in Belize and globally. The current increase in the use of indigenous remedies for doing self-medication by individuals or patients is attached to many reasons. Chanda and Kaneria (2011:1251) enumerated the following as reasons why people engage in the use of indigenous medicines, as follows: patients feeling very uncomfortable talking about their health problems and fear that there will be a lack of confidentiality in handling information related to their health. Additionally, the patient’s fear of misdiagnosis, wrong treatment with western medications, and lack of time by the physician to see the patients were reasons for increased patronage of indigenous therapies.

Religion and cultural beliefs inform the patient’s choice to use indigenous medicines, the cost of those herbs, and the perceived efficacy of such herbs in treating the patient’s condition (Ekor 2014:177). These herbs are readily available and cheap, making them the first line of treatment in many communities.

4.3 SUMMARY OF QUANTITATIVE PHASE

This chapter presents the results obtained in the first phase of the research on indigenous-western therapies usage among hypertensive patients in Belize. A total of 422 participated in the survey. Data were collected utilizing a well-structured and verified questionnaire.

Information collected from participants was grouped into demographic, western medication, and indigenous therapy usage. Collected data were was analyzed using SPSS version 21.0 software. Results are presented in frequency tables, graphs, and charts.

Female participants were more than male participants in the study. The majority of the respondents were diagnosed with hypertension within the last ten years, with those diagnosed within 1 – 5 years having the highest number (n=167; 39.6%) of reported cases, followed by those diagnosed within 6 – 10 years (n=116; 27.5%). The majority (n=335; 33.7%) of the respondents reported being on hydrochlorothiazide, while 12.3% (n=122) were on captopril. Over 30 different plants were mentioned as indigenous therapies used for the management of hypertension in Belize. Beetroot (n=56; 13.3%), garlic (n=45; 10.7%), and aloe vera (n=27; 6.4%) were among the most reported indigenous therapies used for the management of hypertension. Respondents also reported garlic (*Allium sativum*) 70.9% of cases (n=225), lime (*Citrus aurantiifolia*) 32.8% of cases (n=105), while aloe vera (*Aloe barbadensis miller*), 24.4% of cases representing a frequency of 78 as the most common indigenous therapies used for the management of hypertension. The main sources of indigenous therapies reported by respondents were yard/family/friends (n=94; 22.3%) and indigenous therapy vendors/markets (n=69; 16.3%). Leaves (n=64; 15.2%), or a combination of leaves, roots, seeds, or bark (n=161; 38.2%), were majorly reported as the parts used for hypertension therapy.

Participants used indigenous therapies for the management of their hypertension. A few of the participants combined indigenous-western therapies for the management of their hypertension. The major reason given by participants for using indigenous therapies was that indigenous therapies were natural.

4.4 PHASE II DATA COLLECTION, ANALYSIS, AND PRESENTATION OF FINDINGS

4.4.1 Introduction

In the last section (Phase 1), a detailed quantitative analysis is described for the study. In this phase of the study, two data sets were collected on indigenous-western therapies for treating hypertension. The first set of data was collected from patients diagnosed with hypertension who used either or both indigenous and Western therapies to manage hypertension, while the second set of data were collected from vendors of indigenous therapies. In this section, data collected qualitatively from hypertensive patients and vendors of hypertensive therapies were presented to have a deeper understanding of the use of indigenous therapies among Belize's population. This section presents a brief description of the data collection process, data analysis and discusses the second phase's findings. The essential themes and sub-themes categories that emerged from the analysis of interviews are discussed in the following section. The description is in regards to the research objectives and the reviewed literature. The first part of the discussion focused on hypertensive patients, while the second part of the discussion describes and discussed the analysis of interviews from the vendors of indigenous therapies.

4.4.2 Part 1: Patients using medicinal therapies for the treatment of hypertension.

This part of the study presented the data collected from patients suffering from hypertension, commonly known as high blood. Data were collected from patients who had been diagnosed with hypertension.

4.5 BIOGRAPHICAL PROFILE OF PARTICIPANTS (HYPERTENSIVE PATIENTS).

The participants in this phase of the study were 24 diagnosed hypertensive patients who currently use indigenous therapies to manage their hypertension.

The interviews from the 24 participants were analyzed and discussed in this section. The participants comprised 14 (58%) females and 10 (42%) males. The average age of the participants was 56.

4.6 DATA COLLECTION PROCEDURE

Appointments were made with participants through the phone to meet at a place convenient to them. Most meetings for the interviews were conducted at the homes of the participants. A few were conducted at the workplace of the participants. During the quantitative phase, the participants were identified and consent to participate in the study's qualitative phase. The study's purpose and interviews were explained to the participants, and consent was sought and accepted before the interview sessions. Each interview session lasted about 20-45 minutes. Fieldwork notes were taken and recorded, as well as observing non-verbal cues. The researcher gave written notes on respondents' information unique codes to maintain participants' privacy, anonymity, and confidentiality.

4.6.1 Data analysis and management

As described by Vaismoradi and Snelgrove (2019:1), thematic analysis was used for data management and analysis of interviews conducted for this phase. A theme was described as a thread of underlying meanings within similar data pieces that can be combined to give the researcher answers to the study phenomenon (Vaismoradi and Snelgrove 2019:1). The results of the 24 interviews were transcribed using Microsoft Excel and loaded into qualitative data analysis (QDA) Miner Lite version 2.0.6 online software for coding. QDA Miner Lite is free software that is easy to use, generates basic themes, and has capabilities for exporting tables to Microsoft Word or Excel for further analysis. The QDA Miner Lite® has a limitation in that it cannot generate smart charts as done by other applications such as Microsoft Word and Excel. The tables were exported to Microsoft Word, and the Microsoft Word smart art was used to draw graphs for this phase.

The integrated themes and sub-themes generated were presented in narrative passages and used to summarize study findings on indigenous therapies used to manage hypertension in Belize.

4.7 PURPOSE OF THE QUALITATIVE PHASE

As described in chapter one, this study's main purpose was to investigate the use of indigenous-western anti-hypertensive therapies in Belize to develop guidelines for using these therapies. This section of the study was carried out to understand the different indigenous therapies used to manage hypertension and why people use indigenous therapies to manage their hypertension. The objectives of this section are presented below, as earlier described in chapter one.

4.8 OBJECTIVES OF QUALITATIVE PHASE (PHASE 2 – HTN PATIENTS)

The qualitative phase of this study has a few sets of objectives. In order to achieve the aim of this phase, the following objectives were developed:

- To identify indigenous remedies used by hypertensive patients in the management of hypertension.
- To describe the preparations, storage, and usage of indigenous therapies by hypertensive patients in Belize.
- To assess the concomitant use of indigenous-western therapies by hypertensive patients in Belize.

The data were collected and analyzed as stated above, and the following themes and sub-themes emerged from the analysis. These themes and sub-themes are illustrated in table 4.12 below and are discussed in the paragraphs that follow:

4.9 EMERGING THEMES AND SUB-THEMES

Based on the received data that was analyzed, the following themes and sub-themes developed are presented in Table 4.12 and discussed below:

Table 4.12 Themes and sub-themes revealed during data analysis of hypertensive patients.

	Themes	Sub-themes
1.	Indigenous medicinal plants for hypertension	1.1 Medicinal plants used for hypertension 1.2 Knowledge and source of indigenous therapies 1.3 Duration of use for medicinal plants in hypertension
2.	Preparation of medicinal plants for hypertension	2.1 Plant parts used for therapy 2.2 Preparation of medicinal plants 2.3 Administration of medicinal plants for hypertension therapy
3.	Efficacy of medicinal plants for hypertension	3.1 Beliefs on the effectiveness of medicinal plants and the duration of use 3.2 Safety and adverse effects of medicinal plants 3.3 Concomitant usage of medicinal plants with western medications 3.4 Availability and cost of medicinal plants

4.9.1 Theme 1: Indigenous medicinal plants for hypertension

The World Health Organization (WHO) defines indigenous medicines as plants or plant products that possess medicinal properties utilized for therapy (WHO, 2019:1). Currently, many countries are widely embracing medicinal plants for the treatment of various diseases and conditions (Ekor 2014:117; Mphuthi 2015:223; Shaikh, Thomas, and Chitlange 2020:1008).

Additionally, medicinal plants for the management of hypertension have been surveyed in many countries like Pakistan, Iran, Brazil and reported in some publications (Al Dasi et al. 2016:1; Baharvand-Ahmadi, Bahmani, Tajeddini, Rafieian-Kopaei, and Naghdi 2016:1; Meresa, Fekadu, Degu, Tadele, and Geleta 2017:1; Malik, Ahmad, Bussmann, Tariq, Ullah, Alqahtani, Shahat, Rashid, Zafar, Sultana, and Shah 2018:789). In Belize, few studies have been conducted on indigenous therapies to treat and manage hypertension, even though the practice exists. The participants interviewed revealed the medicinal plant they use to manage hypertension, the sources of their knowledge, and the duration they had taken indigenous therapies for the treatment and management of hypertension. The sub-themes were generated during the analysis, and participants indicated that they used medicinal plants as indigenous therapies for the management of their hypertension as quoted below by participants:

> *"To treat my blood pressure, I have been doing several things because I really intend to cure it. I have been having a lot of teas and eat plenty garlic and drink garlic capsules as well. I have been drinking green tea and moringa tea. I have also been eating moringa leaves in my salad for lunch. You see there is cure in nature I only need to find it."* **P1**
>
> *"Many people use many things for their hypertension. Sometimes I use a combination of some herbs sometimes for my hypertension, but majorly, I use the fruit Annatto."* **P5**
>
> *"I am 57-years-old, and I suffered from arthritic joints due to my youthful days of football am now hypertensive. I take soursop leaves for my hypertension."* **P19**

The three sub-themes that emerged from participants under these themes are described and discussed below.

4.9.1.1 Sub-Theme 1.1: Medicinal plants used for hypertension

According to the WHO (2019:8), herbal or medicinal plants are preparations obtained from plants or herbs that contain active ingredients used for the treatment or management of diseases, usually by indigenous people. The hypertensive participants from this study reported various medicinal plants used to manage their hypertension. The different therapies used included but not limited to soursop, breadfruit, and trumpet tree leaves, pineapple, lemongrass, green teas, cat's claw seed, garlic, annatto fruit, moringa, serosi, and bukut leaves. Medicinal plants have been reported to be used either as a single plant or as a mixture of plants.

The following quotations evidence some of the medicinal plants mentioned for the management of hypertension:

> *"I take the pineapple tea for my pressure."* **P2**
> *"I take a combination of bukut leaf and serosi for my pressure."* **P7**
> *"I use soursop leaf and moringa for my pressure."* **P8**
> *"I take garlic and moringa in tea to treat my blood pressure."* **P10**
> *"I use cat's claw seed to treat my hypertension."* **P16**
> *"I use Breadfruit leaves for my pressure."* **P22**

Based on the participants' quotations above, various medicinal plants have been used to manage hypertension. As noted earlier and as shown by the quotations, some used single medicinal plants to manage hypertension, while others used a combination of plants. Many medicinal plants have been reported to manage hypertension (Ekor 2014:117; Landazuri, Chamorro, and Cortes 2017:1; Rawat, Jugran, Bahukhandi, Bahuguna, Bhatt, Rawal, and Dhar, 2016:154). Although some of the reported medicinal plants have verifiable scientific evidence in terms of their pharmacological activity, many are still being studied, and information obtained from indigenous users provides useful understanding for scientific research into such medicinal therapies. The results obtained in this phase of the study showed that hypertensive patients use various indigenous therapies to manage hypertension. These plants play a vital role in managing hypertension in Belize and have significant health implications for public health. The results of this phase of the study corroborated the quantitative phase of the study.

4.9.1.2 Sub-theme 1.2: Knowledge and source of indigenous therapies

The Oxford online dictionary describes knowledge as the facts, information, and skills acquired by a person through education or experience. This knowledge could be in terms of the theory or practical understanding of a subject matter. Similarly, the WHO (2019:8) describes indigenous medicine and the comprehensive knowledge and practices of indigenous people to diagnose, prevent, treat, or manage diseases. Hypertensive participants were asked how they acquired their knowledge of indigenous therapies. Most of the participants indicated that the knowledge of indigenous therapies was passed down from generation to generation. The current results resonate similar study by Mphuthi (2015:215). The participants reported their sources of knowledge about medicinal plants to come from family members, community, practitioners, or other sources, as evidenced by some of the participant's quotations below and summarized in Figure 4.19 below.

> *"My mom, grandma, great grandmom, and everyone always use herbs. We are from the village, and the village people use herbs for everything until Whiteman came with their propaganda. There is always something around to cure you. We live off the land."* **P4**
>
> *"You need to understand that in the villages, these remedies have been passed down from generation to generation. So, I grew up knowing herbs and what they do."* **P5**
>
> *"I learned from my grandmother. From I was a little girl, she always boils bush for us to drink. We live on bush, and it helps with many things."* **P9**
>
> *"I grew up watching my grandmother and other relatives use a lot of herbs that we grow in our yard for many different things. It seems to work for them, and I have seen it working for me……."* **P23**
>
> *"I learn that from the Internet, the Bush Medicines of Belize."* **P22**

As shown by the quotations from participants, most of the information is from the community. Indigenous vendors' also gave some advice to the patients regarding the use of medicinal plants, as shown in Figure 4.19 below:

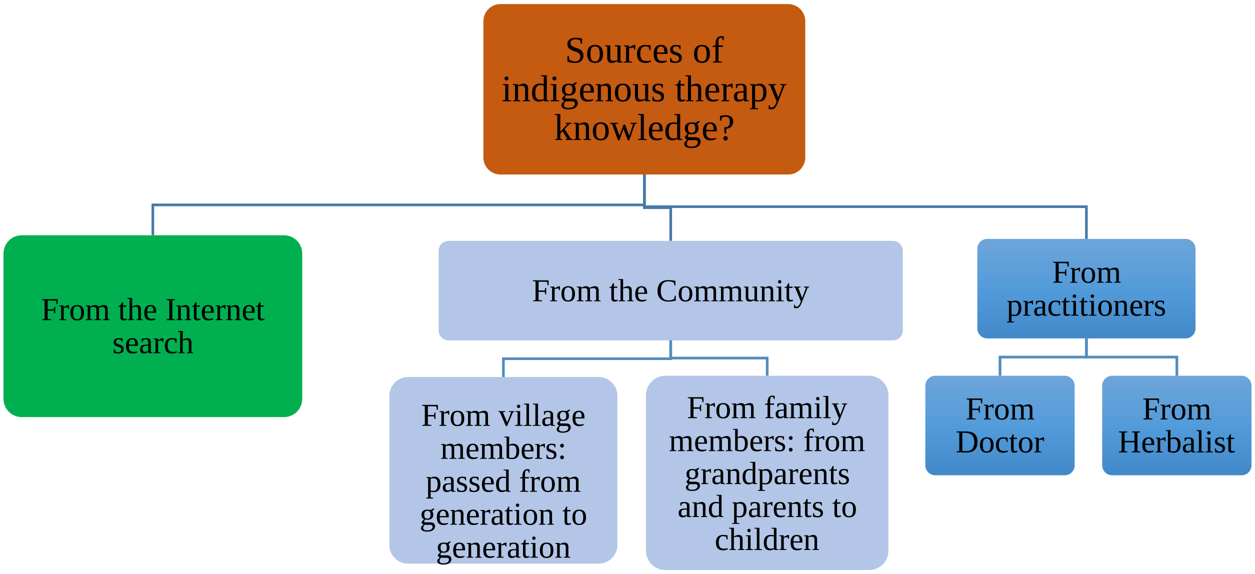

Figure 4.19. Knowledge and sources of indigenous therapies

Most hypertensive participants reported knowledge of medicinal plants being handed down to them from generations before them. According to the World Health Organization (WHO 2019:12), many countries embrace indigenous therapies handed over to them by their forefathers. The WHO's submission is also the Belize case, where many people rely on indigenous therapies to manage various diseases. This reliance on indigenous therapies is mostly seen in older people who inherited their ancestors' knowledge, as seen in this study phase. Even though indigenous therapies have been used for generations and mostly the knowledge is passed from one generation to the other, as seen in this study, many times the challenge is that such information is not adequately documented and hence some vital ingredients is likely to be lost along the line over the years (Baharvand-Ahmadi et al. 2016:1; Meresa et al. 2017:1; Malik et al. 2018:789.). The dynamics of migration from rural to urban communities by the younger generation, the advent of education, and Western therapies play vital roles in indigenous therapies knowledge being lost (Malik et al. 2018:789). In addition, with some younger generations, the outright lack of interest could play a significant role in the ineffective transmission of indigenous therapies knowledge from older folks. For instance, Malik et al. (2018:789) reported that in Northern Pakistan, young people lack interest in indigenous medicines, as such transmission of such knowledge from older people is becoming difficult, especially because younger people have ease of access to readily available Western medications. Even though the purpose of this phase of the study is to identify and gain insight into indigenous therapies used in the management of hypertension in Belize, the study results will also serve as useful documentation of indigenous therapies, especially those used in the management of hypertension in Belize.

4.9.1.3 Sub-Theme 1.3: Duration of use of medicinal plants in hypertension

In an attempt to appraise the length of time hypertensive participants have been using indigenous therapies for the management of hypertension, the researcher asked the following question: "how long have you been using medicinal plants for the management of hypertension?" It was noticeable that the participants used medicinal plants not only for the management of hypertension but also for other diseases. Most participants claimed that medicinal plant use for managing hypertension was majorly dependent on the number of years diagnosed with hypertension. Whereas some of the participants did not specify the duration of usage, most participants reported short-term, medium-term, and long-term use of medicinal plants to manage hypertension. The evidence is shown by the participant's quotation below and the summary in Figure 4.20

> *"I do not remember, but I know it is for a very long time."* **P13**
>
> *"All my life, I drink herbs for everything. I believe in herbs. They are very effective in treating many diseases."* **P4**
>
> *"I have been doing these herbal remedies for the last three months. I have just been diagnosed with hypertension, and I am looking for a cure."* **P1**
>
> *"Oh men, I have been taking herbs for a long time, but since I was diagnosed with pressure three years ago, I started taking annatto for my pressure."* **P5**

"I started taking herbs when I found out I had high blood pressure, so that's about ten years ago, and since then, I have been taking herbs for my pressure." **P7**

"I have been using my bush on and off for over ten years." **P11**

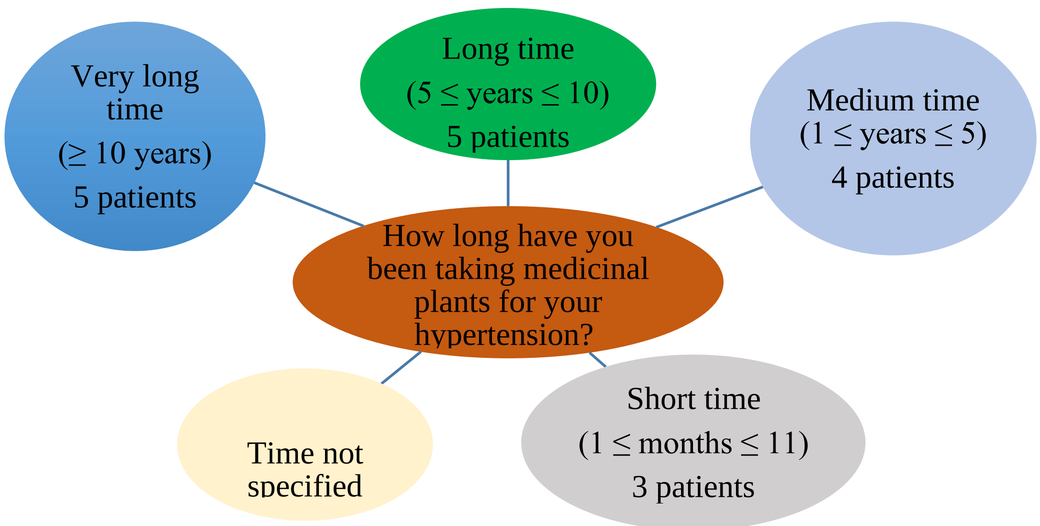

Figure 4.20. Length of time patients have been using indigenous therapies for hypertension

The desire to use medicinal plants for the management of a variety of diseases has significantly increased, and although many factors are responsible for this, the main reasons are the perceived safety of medicinal plants and their cheapness when compared to western medications (Ekor, 2014:117; Shaikh et al. 2020:1008). In Belize, for instance, the provision of Western medications from government-owned hospitals is free to all hypertensive patients. However, because medicinal plants in Belize are profoundly rooted culture in almost all ethnic groups, especially among the Maya, Kechi, Garinagu, and East Indians, the habit is difficult to let go of even with the freely accessible Western medications. The desire to maintain the originality of cultural and ethnobotanical practices among natives has been reported as a means to strengthen cultural and ethnic identities from the colonial era (Mans 2016:1; Mans 2017:1; Mans et al. 2017a:1). In addition, the vast rainforest of Belize and biodiversity provides the right environment and atmosphere for the use of many medicinal plants for the treatment of hypertension and other diseases.

The hypertensive participants in this study have reported using medicinal plants for less than a year to as much as ten years and beyond to manage their hypertension, possibly because of generational use, availability, and culture.

4.9.1.4 Theme 2: Preparation of medicinal plants for hypertension

Preparation is described as the different methods employed to extract the active ingredients from parts of a plant, plant material, or a combination thereof from a medicinal plant (WHO 2019:8; Malik et al., 2018:789). Different medicinal plants' preparation methods have been described to include extracts, powder, boiled teas, scorched, steamed, poultice, infusions, and decoctions (Malik et al., 2018:789; Baharvand-Ahmadi et al. 2016:1; Boadu and Asase, 2017:1). In this phase of the study, the researcher aimed to identify the medicinal plants for managing hypertension in Belize and document their preparations. Documentation of preparation methods is essential if indigenous therapy knowledge is to be preserved. Due to acculturation and biodiversity, indigenous knowledge of medicinal plants has been reported to be on the decline and, in some cultures, outrightly lost (Boadu and Asase, 2017:1). The authors further stated that to ensure that indigenous therapies' rare heritage is passed on to future generations, the need to describe and document such knowledge becomes paramount. To support indigenous therapies' importance, the World Health Organization (WHO) partners with several member countries to document and share information on indigenous medicines (WHO, 2019:10). Such information is regularly updated to provide current information on indigenous therapies available for the public in member nations. The document was also designed to provide some guidelines on medicinal plants to manage various diseases.

From the sub-themes generated during the analysis, most participants reported the plants part used to manage hypertension, how the plants are prepared for use in hypertension, and how they are administered. Additionally, the shelf-life of medicinal plant preparations was also described by the participants, as discussed below.

4.9.1.5 Subtheme 2.1: Plant parts used for therapy

Participants were asked the part or parts of the medicinal plant they used to manage their hypertension. Most participants reported leaves as the common part of the medicinal plant used to manage their hypertension. In addition to leaves, fruits, roots, seeds, stems, and whole herbs have been reported by a few participants as parts of plants used to manage their hypertension. The participants' responses are supported by their quotes below:

> *"I use cat's claw seed…"* **P16**
> *"I use soursop leaves…."* **P6**
> *"I use the leaves from the moringa tree…"* **P9**
> *"I use breadfruit leaves…"* **P22**
> *"I have been using Trumpet tree leaves…"* **P23**
> *"I take the soursop leaves, and sometimes I take the moringa leaves."* **P12**
> *"I use a mixture of herbs to make juice.* **P4**
> *"I use the ginger, garlic, lime, cinnamon stick."* **P18**
> *"I take lime and garlic…."* **P13**

Reports by hypertensive participants on the medicinal plant part used to treat hypertension showed that a single part of a medicinal plant such as leaves (P6) could be used for hypertension or a combination of leaves (P9). Seeds (P16), roots, stem sticks, and pods (P18) have also been reported to manage hypertension in Belize. Most participants in this phase of the study reported using the leaves of a medicinal plant to manage their hypertension.

The results noted in the current phase of this study support Malik et al. (2018:789), who conducted a study on ethnobotanical anti-hypertensive plants used in Northern Pakistan. The study reported that stem, root, flower, bark, leaves, seed, aerial parts, fruit, and whole herbal plant were used by indigenous Pakistani people to manage hypertension. Their report further indicated that most respondents (55.1%) reported using leaves to manage their hypertension. Similar studies have shown that leaves are the highest plant part used than other medicinal plants, with 57% and 36% reported by Boadu & Asase (2017:1) and Baharvand-Ahmadi et al. (2016:1), respectively.

4.9.1.6 Subtheme 2.2: Preparation of medicinal plants

In order to ensure the quality and consistency of medicinal plants, methods of preparation, quality control, and standardization of medicinal plants are fundamental (Nafiu, Hamid, Muritala, and Adeyemi 2017:171). Different medicinal plants' preparation methods have been described to include infusions, decoctions, boiling, teas, syrups, concoctions, powders, and chemical extractions (Ekor, 2014:117; Nafiu et al. 2017:171; WHO, 2019:1; Shaikh et al., 2020:1008). Variations in the medicinal plants, the plants' identity, and adulteration have been reported to be factors that affect medicinal plant preparation (Nafiu et al. 2017:171). When a plant part is boiled in water until the water volume is reduced, usually to approximately half, the extract is considered a decoction. Similarly, soaking a plant part in the water at room temperature for more than an hour is called infusion. The juice is made from medicinal plants by blending the fresh part of the medicinal plant with water (Malik et al., 2018:789).

In the current study phase, the researcher attempted to get details of preparation methods for medicinal plants used by hypertensive patients to manage their hypertension. Although no standardized method was reported by participants, boiling of medicinal plant part was the commonly reported method of preparation, as evidenced by the quotations below:

> *"I take the pineapple tea……. I wash a large pineapple, then I peeled the skin and boil it in about a 1 liter of water for like 20 minutes, then I leave to cool for another 20 min more. Then I left to soak for one hour, then I strain."* **P2**

> *"I use soursop leaves and moringa leaves. I have a soursop tree right in my back yard. I pick the leaves when they are big and put them to boil for about*

15 minutes to about half an hour. When that is cooled, I put it in the fridge…." **P8**

"I take garlic and moringa in tea... I normally boil the garlic in the water and add a tablespoon of the moringa powder to the garlic water. The moringa powder I get from my mom, she prepares it right here because we have the tree. Garlic is better boiled because you no smell it all day like when you eat it." **P10**

"I use soursop leaves…I boil the leaves in water and drink; however, I also boil the green leaves. I just wash the leaves and put them in hot water for about half an hour; then I strain it." **P6**

"I take a combination of bukut leaf and serosi……. I boiled water and added the leaves. After I add the leaves, I boil for about 5 minutes more; then I take it off the stove." **P7**

"I use the leaves from the moringa tree to cure my blood pressure. I soak it in water and keep it in the refrigerator……." **P9**

"I take soursop leaves. I make tea by boiling about ten leaves in 2-3 cups of water." **P14**

"I drink lemongrass tea. I prepare it by boiling a handful of the grass blades in 1-2 cups of water." **P15**
"I use a mixture of herbs to make juice. I blend the moringa leaves along with garlic, ginger and lime to make the juice……" **P4**

"I use the ginger, garlic, lime, cinnamon stick. Boil slowly for 10 min. Leave it covered to keep the steam in the pot. Left it to rest and then serve, add honey for a nice taste." **P18**

> *"I take breadfruit leaves for my pressure. I get the leaves from my farm and dry them first for about a week in a special container, out in the sun. I then weigh about one pound of it and boil it in a stainless steel pot. I will use like ten leaves for about a liter of water."* **P3**

> *"To use lemongrass for high blood pressure, I simply steep dried or fresh lemongrass in a cup of hot water for five to 10 minutes, then strain and add a sweetener. I also used ready-to-use lemongrass tea bags. I Pour 1 cup boiling water over 1 to 3 teaspoons of fresh or dried lemongrass. I then steep for at least five minutes. I will strain the tea and enjoy hot or add ice cubes for iced lemongrass tea. It is very nice."* **P17**

Most hypertensive respondents reported decoctions as the means of medicinal plant preparation for the management of hypertension. Washed pineapple skin is boiled for about 20 min in a liter of water (P2), big leaves of moringa are boiled in water for about 15 minutes (P8), moringa powder is added to boiled garlic (P10), ten leaves of soursop are boiled in 2-3 cups of water (P14), and a handful of lemongrass blades are boiled in 2-3 cups of water. As noted in this phase of the study, hot water extractions of leaves resonate with previously reported studies where participants indicated hot water extraction as the most used method of preparation, while the oral route is the common route (Malik et al. 2018:789). Participants also reported that they prepare their indigenous remedies by boiling them in a pot filled with water for an average of 5 to 30 minutes. After it was boiled, they would leave the drink to cool and be strained before drinking.

The lack of standardization in the preparation of medicinal plants was observed in this phase of the study. For instance, only a few respondents indicated the number of leaves they used to make preparations. Some indicated mature or large-sized leaves, while others did not. The sizes of leaves of different medicinal plants vary according to the developmental stage of the tree. In addition, only a few indicated the amount of water used to boil the medicinal plant part. Finally, the time it took to boil the medicinal plant part was not stated by many despite the researcher's effort to extract such information.

The duration of boiling of the medicinal plant mentioned by a few respondents' ranged from 15 to 20 minutes of boiling. Despite the lack of standardized reporting on preparation methods for medicinal plants observed in this phase of the study, medicinal plants' decoctions for hypertension are common practices reported globally (Mphuthi 2015:259; Malik et al. 2018:789; Baharvand-Ahmadi et al. 2016:1; Boadu and Asase 2017:1). The current results seen in this phase of the study support these findings.

4.9.1.7 Subtheme 2.3: Administration of medicinal plants for hypertension therapy

Boadu and Asase (2017:1), in a study of herbal medicines used in the treatment of human diseases in Ghana, reported oral administration as the common route for herbal administration. Other medicinal plant administration routes have been described to include topical, rectal, inhalational, and drops. The active ingredient in a medicinal plant and the disease being treated usually determines the administration route (Busia 2016:20; Boadu and Asase 2017:1). Boadu and Asase (2017:1) further reported that absorption of medicinal plants containing alkaloids is readily absorbed from the gastrointestinal tract system, while the best routes for administering essential oils of terpenoids are nasal and dermal routes. Even though infusions can be administered rectally and nasally, most infusions and decoctions have been reported to be best administered orally (Busia 2016:20; Boadu and Asase 2017:1).

Interview analysis of hypertensive patients in this phase of the study showed that the main route for administering medicinal plants in managing hypertension was the oral route. The dosage of the medicinal plant taken by the participant seems conflicting among participants but helpful. The frequency of intake of the medicinal plant for hypertension was also reported based on the interview analysis. The quotations below show evidence of routes, dosage, and duration of intake as reported by participants:

> *"I blend the moringa leaves along with garlic, ginger, and lime to make the juice that I drink two times a day, in the morning and at night, I have a glass full." "Usually, I just take as much as will make a glass of juice."* **P4**

"I pick the fresh leaves of Trumpet tree and put in boiling hot water like a tea and drink one cup of tea two times a day." **P23**

"I drink lemongrass tea. ……….I can drink the tea anytime, but I usually drink it in the morning and at night." **P15**

"I use the leaves from the moringa tree…….. I soak it in water and keep it in the refrigerator, and I drink it all day long instead of regular water." **P9**

"I take a combination of bukut leaf and serosi…... I boil …………when it is cool, I drink a glass every morning and night." **P7**

"I use the soursop leaf and moringa…………when that is cooled, I put it in the fridge and drink a glass every day." **P8**

"I use the fruit Annato. I always boil the fruit and drink the juice throughout the day. I take like half a glass." **P5**

Most respondents in this survey reported the oral route as the main route for medicinal plant intake. Respondents take medicinal preparations as decoctions, teas, juices, mixtures of boiled plant parts, or herbs to manage their hypertension. Half a glass to full glass of medicinal plant therapies is taken either once or twice per day, as reported by most participants. Some participants reported taking the therapy anytime and for the entire day. Apart from participant 8, who reported refrigerating the therapy, most participants were silent about the preparation's shelf-life, while others seemed to prepare fresh teas or decoctions each day. The respondents indicating varying dosages for medicinal plants in this study corroborated similar research reports conducted in other places (Ahmed, Mahmood, Ashraf, Bano, Tahir, and Mahmood 2015:109; Malik et al. 2017:789).

The major issue with the dosing of indigenous therapies, especially those obtained from medicinal plants, is knowing the correct concentration to use. The time when herbs or plants are harvested presents a unique challenge in the concentration of active ingredients found in medicinal plants. For instance, during the rainy season, the active ingredients found in plants and herbs are diluted due to the availability of rain, whereas in the dry seasons, plants seem to conserve water as such has a high concentration of active ingredients compared to the rainy season (Lawson and Rand 2019:561; Nascimento, Luiz, Vega, Villela, and Nascimento 2019:18293). Depending on the season, therefore, the plant or herb is harvested for medicinal usage, the concentration of what is extracted and used varies. Additionally, the extraction method, the amount of water used for the extraction, and the leaves' size or weight could play a role in the dosage and potency that was eventually consumed by the participant. In this study, participants reported drinking "half or full glass," and that they drink the extracted therapy "every day, all day or when they feel the pressure." The results observed in this study resonate with previously published studies where the season and time when medicinal plants are harvested affect their concentration (Lawson and Rand 2019:561; Nascimento et al. 2019:18293; Nare, Pienaar, and Mphuthi 2018:1)

4.9.1.8 Theme 3: Efficacy of medicinal plants for hypertension

The importance and usefulness of indigenous therapies cannot be overemphasized. The practice has been recognized, approved, and encouraged by the World Health Organization (WHO 2019:11). In its 2019 global report on traditional and complementary medicine, a General Program of Work (GPW13) on traditional and complementary medicines came into effect by the World Health Organization (WHO 2019:11). The GPW13 is a priority strategy where traditional and complementary therapies are promoted for universal health coverage, health emergencies, and promoting healthier living globally (WHO 2019:11). The WHO's recognition of indigenous medicine could only span from the therapy's effectiveness, and historically, long before the WHO's declarations, many indigenous populations have used indigenous therapies to treat their ailments. Participants in this study gave examples of how their health condition improved because of indigenous therapy usage. In this phase of the study, the beliefs about medicinal plants' efficacy, safety, concomitant use with Western medications, and medicinal plants' availability reported by participants and revealed by emerged sub-themes are discussed. No doubt, participants are confident about the efficacy of medicinal plants in the management of hypertension, as evidenced by the quotes below:

> *"You see, there is cure in nature I only need to find it."* **P1**

“Very, very effective even the doctors are surprised that my blood pressure is under control, and I told them I was not taking their medicines.” **P12**

“Anytime I monitor my hypertension, it is under control. My daughter bought me a pressure measuring instrument that I use, and my pressure is under control. My friend Mr._____ uses hospital medication, but my pressure is more under control than his own. So, I know that mine is more effective than hospital drugs.” **P20**

“Look, man! These herbs are very effective—nothing like them. I have been using them to manage my hypertension well with only the herbs I monitor it, and it's not high. It works, man! Hehe.” **P24**

4.9.1.9 Subtheme 3.1: Beliefs on the effectiveness of medicinal plants and duration of use

Many medicinal plants have traditionally shown great potential in managing various diseases, and historically, many Western medications have been discovered in medicinal plants (Al Dasi et al. 2016:1). However, with the growing use of medicinal plants in both developed and developing nations, there is still insufficient knowledge about how they produce their mechanism of action in treating or preventing disease progression (Ekor 2014:117; Shaikh et al. 2020:1008). In Belize, traditional and cultural beliefs on indigenous therapies are robust and have been preserved from the pre-colonial era; thereby, ethnic heritage is passed on to generations as a means of strengthening communities. These beliefs and cultures as also been reported in similar studies in South Africa (Mphuthi 2015:220; Nare et al. 2018:1) and Suriname (Mans et al. 2017b:1). Participants in this phase of the study reported that medicinal plants used for the management of hypertension are effective in lowering blood pressure, as evidenced by the quotations below:

Herbal medicines come from nature, and they are the best. Every time I go to the doctor, my blood the pressure is normal. It has to be the herbs that I take because I do not take the other medicines at all. However, I still go to *the doctor and check mi pressure, and they give me the hospital medications, but I don't take them. I only use mi herbs.* **P6**

The herbs work very good. Most times, I don't take my other medicines that the doctor gave me. **P8**

I think it helps me a lot because I keep my weight down. I had a big belly, but now it's gone down a lot, and my feet no swell up again. **P2**

Drinking a glass of lemongrass juice in the morning helps lower high blood pressure and boost blood circulation in the body. It also helps to get rid of uric acid, harmful toxins, and fats, as it works as a diuretic to cleanse and detoxify the body. It increases the frequency and quantity of urination, which helps to flush out bad cholesterol and other toxins. **P17**

Presently, the medicinal plants available in Belize have not been extensively studied and described, even though the practice of using medicinal plants has existed from time immemorial. Although many of the participants were not able to provide insight into the biological activity of the medicinal plant they are using for their hypertension, most of them reported a lowering of their blood pressure, as evidenced by the fact that some of the participants did not take their medications but went to the hospital regularly to check their blood pressure (P6, P8). The participants indicated that Western practitioners always verified their claims of indigenous therapies' effectiveness to lower their blood pressure. The effect of medicinal plants was described by most participants and not necessarily the mechanism of the action of the various medicinal plants they are using for their hypertension. Participant P17 described the effect of lemongrass as having antioxidant and diuretic effects.

Although very little scientific evidence is currently available in Belize regarding medicinal plants for hypertension, the revelations from hypertensive patients give insight and raise the need for extensive scientific evaluations of medicinal plants used in Belize. A comprehensive pharmacological evaluation of these medicinal plants will provide further guidelines for their practical usage and prevent the unforeseen risks of adverse effects.

When hypertensive participants were asked the expected time it would take the indigenous therapy to bring relief to their hypertension, participants reported various durations of use and indicated that they had been drinking the treatment for different lengths of time. Some participants mentioned that they had been drinking the herbs for about three months, while others for more than ten years. The quotes from the participants expressed some of their beliefs, as shown in the quotes below:

> *"I don't know if it cures it, but I take it almost every day."* **P13**
>
> *"There is no cure, but if I feel good, then I don't take both my bush and medications."* **P8**
>
> *"The herbs make you feel good fast. I don't think it will cure the pressure, but they work fast."* **P6**
>
> *"I can't say how long because that would depend on the person and how they take care of themselves. For me, I will take the herbs as long as it keeps me feeling good, and it does."* **P4**
>
> *"Once you take it daily as a tea, your pressure will never go high no matter what. But you also need to watch what you eat and take care of yourself."* **P5**
>
> *"The way I know it is that you can't cure hypertension. So, all my life, I will take soursop to make sure I stay well and healthy. It is possible there may be another herb somewhere that I can use to cure it, but until then, I will use soursop. Also, it is possible the Whiteman told us that there is no cure, so we can continue to use his medicines, but one day we will find a cure. I am sure of that."* **P24**
>
> *"The herbs are to be taken for the rest of your life."* **P15**
>
> *"Well, my elders tell me that I cannot stop taking the trumpet tree leaves, or else my pressure will go up again."* **P23**

One common consensus among participants is that the indigenous therapies do not cure hypertension, even though many confessed that they effectively control high blood pressure. Although a wide range of antihypertensive medications is available for managing hypertension to date, no cure has been found for this cardiovascular disorder (Esler, Lambert, Schlaich, and Schlaich 2016:1996). The choice of medicinal plants as a substitute for the management of hypertension may have its value, especially since it is related to cultural perceptions, yet to date, no cure has been reported in the use of medicinal plants or any medication for the cure of hypertension (Esler et al. 2016:1996). Lifestyle modification, prescribed medications, and indigenous therapies are used to manage hypertension (Bakris 2016:1). The medicinal plants' inability to cure hypertension as reported by participants' supports previously reviewed studies (Malik et al. 2018:789; Baharvand-Ahmadi et al. 2016:1; Boadu and Asase 2017:1).

4.9.1.10 Subtheme 3.2: Safety and adverse effects of medicinal plants

The global increase in the awareness of indigenous therapies, mostly medicinal plants, is perceived to be safe and efficacious simply because they are found naturally coupled with the long ancestral history of linkage to African folklore beliefs and practice has led to people consuming indigenous therapies (Mphuthi et al. 2015:135; Mphuthi and Pienaar 2017:1; Mans et al. 2017a:1). For instance, generally, it is common for people to try indigenous remedies before coming to the hospital (Mphuthi 2015:30); this is also a common practice in Belize. Some participants combined indigenous remedies with Western medications for the treatment of ailments. While therapies using medicinal plants have always reported the potential efficacy of most indigenous products, the majority of such remedies remain untested, with their use remaining poorly monitored (Ekor 2014:117; Shaikh et al. 2020:1008).

The resulting consequences of this are inadequate knowledge of their possible adverse reactions, their mode of action, possible contraindications, and possible interactions with the already existing Western pharmaceuticals and functional foods that can promote the rational and safety of medicinal plants (Chanda and Kaneria 2011:1251). When participants in this study were asked if they experienced side effects of medicinal plants for managing hypertension, most of them reported not experiencing any side effects. However, a few participants reported dizziness, stomach upset and burns, bad feeling, drops of pressure, and sugar, and a few participants were not sure. Some of the quotes are shown below and summarized in Figure 4.21 below.

“None that's the good part about taking natural remedies; they cause you no harm at all.” **P10**

“No, man! No side effects at all. These are natural herbs given to us by nature. They do not harm you if you take the right amount.” **P24**

“Nope, I don't experience any side effects.” **P22**

“Sometimes, my stomach would get a little upset.” **P2**

“Yes, I have. Sometimes the herbs will take my pressure and sugar too low.” **P7**

“If I drink it in the morning, my stomach would burn, so most times I take it at night after I eat.” **P13**

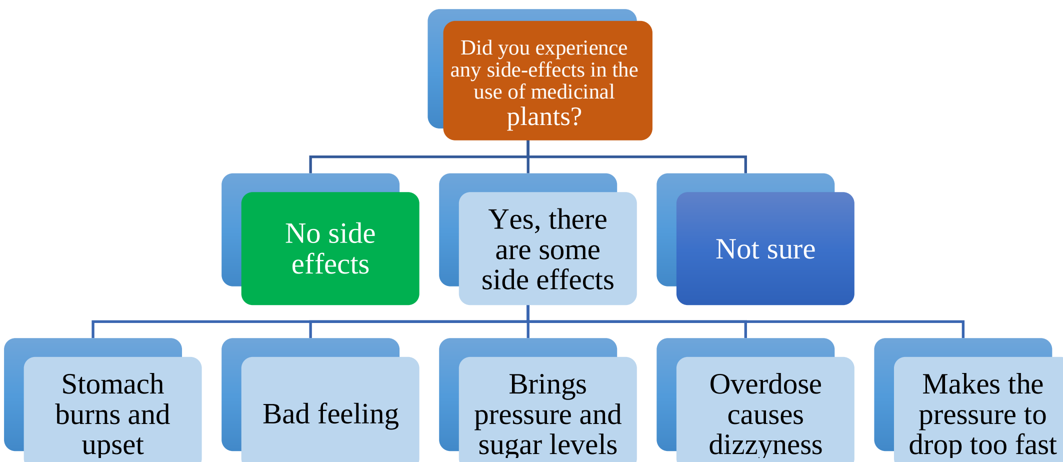

Figure 4.21 Reported side effects in the use of medicinal plants for hypertension

The utilization of indigenous therapies and supplements has expanded tremendously in recent years, with over 80% of individuals depending on them as part of primary healthcare (Ekor 2014:117; Al Disi et al. 2016: 326; Shaikh et al. 2020:1008). Even though indigenous therapies have demonstrated promising potential, the efficacies of a decent number of such therapies remain untested, and their utilization is either inadequately checked or not observed by any means (Ekor 2o14:117; Shaikh et al. 2020:1008). This, therefore, results in insufficient information on indigenous therapies’ method of activity, potential adverse responses, contraindications, and interactions with existing pharmaceutical products. A significant issue in the use of indigenous therapies is that of safety, which makes it essential for studies into their activities and for regulatory bodies to put in place measures for the safety of public health (Ekor 2014:1; Shaikh et al. 2020:1008). Additionally, concerns with indigenous therapies' adverse effects and interactions are because medicinal plants have not been refined and process for toxicity; therefore, the likelihood of drug-herb or herb-herb interactions and adverse effects are likely to occur (Ekor 2014:117; Shaikh et al. 2020:1008). Although some of the participants reported not experiencing side effects with medicinal plants, a few mentioned that they experienced side effects ranging from stomach upset, dizziness, bad feeling, and the dropping of both blood glucose and pressure. The general perception that medicinal plants are safe because they are natural has been reported in other studies (Ekor 2014:117; Malik et al. 2018:789; Baharvand-Ahmadi et al. 2016:1; Boadu and Asase 2017:1; Shaikh et al. 2020:1008). The results of this study support these previous studies.

4.9.1.11 Subtheme 3.3: Availability and cost of medicinal plants

The patient's choice to use indigenous medicines is also informed by religion, cultural beliefs, the cost of those herbs, and the perceived efficacy of such herbs in treating the condition (Ekor 2014:117; Al Disi et al. 2016:326). Medicinal plants are affordable and readily available, making them the first line of treatment in many communities (Ekor 2014:117; Shaikh et al. 2020:1008).

Hypertensive participants in this phase of the study reported that most of the medicinal plants they used to manage their hypertension are found within the community, while a few will buy some of the ingredients in the market. The claim on availability and cost of medicinal plants among participants is evidenced in Figure 4.22 and the quotes below:

> *I spend nothing. Soursop leaves were free. I have a soursop tree and my neighbors too."* **P14**
>
> *I make my own soursop leaves tea because I have soursop trees in my yard, so I do not spend money to purchase it."* **P21**
>
> *I do not spend any money since it grows in the wild and readily available."* **P5**

I do not spend anything on the moringa leaf. My friend in Ladyville has a tree, and she sends for me." **P9**

The tea does not cost any money, but the pills from the hospital cost money when the hospital runs out, I have to buy the pills. The bush to make the tea is available and free." **P15**

I spend about $20 - $25 per month (1 big pineapple for the week costs $5). It's not cheap. One pineapple gives you tea for 2-3 days." **P2**

The only thing I buy is garlic. I have everything else available. The garlic cost about $6 or $8 for the month." **P4**

Honestly, every month I buy like $15.00 worth of cats claw. Sometimes I use all, but most times I don't." **P16**

Figure 4.22 below summarizes the responses of the participants. Most participants reported that they did not spend any funds to purchase the therapies because they either grew them at home or were found within the community. Friends and family members also supply medicinal plants to their relatives at no cost. Some participants reported that when they do not have a supply, they buy from the market, and the cost is reported to be less than 50 Belizean dollars in a month.

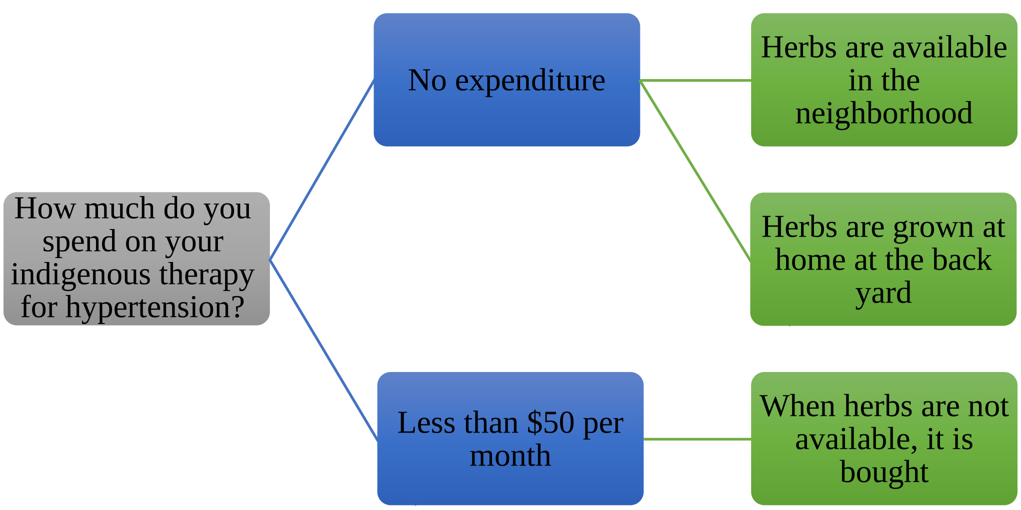

Figure 4.22 Availability and cost of medicinal plants for hypertensive therapy

High morbidity and mortality rates with most diseases have always been associated with high hospitalization rates and an increase in the cost of therapy (McPhail 2016:143). Besides, long-term management of diseases such as hypertension and other comorbidities has been reported to be the greatest challenge for patients and healthcare-givers (McPhail 2016:143). Hypertension and related diseases it has been reported to have a high cost of management, especially that prescribed Western medications are expected to be taken for life since cure cannot be attained (Kastor and Mohanty 2018:1995). In addition, the cost of western medications, cultural beliefs (WHO 2019:11), and the perception that indigenous therapies are harmless because they are natural (Ekor 2014:1; Shaikh et al. 2020:1008) are excellent incentives to make people with hypertension to explore alternative methods for hypertension management. Most of the participants in this phase of the study did not have to pay for the indigenous therapies they used for their hypertension because they are found in abundance in nature, within their homes, communities, or readily available in the market. The report by hypertensive patients on indigenous therapy costs confirms its ease of availability, accessibility, affordability, and perhaps effectiveness as a drive for usage. This study resonates with previously published studies on the availability and affordability of medicinal plant therapies to manage hypertension and other diseases (Ekor 2014:117; Malik et al. 2018:789; Baharvand-Ahmadi et al. 2016:1; Boadu and Asase 2017:1).

4.9.1.12 Subtheme 3.4: Concomitant use of medicinal plants with western medications

Most of the participants expressed that medicinal plants were the only therapy they used to manage their hypertension, while few others acknowledged that they combined the medicinal plants with prescribed Western therapies. Some of the participants who used only medicinal plants still visited their doctors to check their blood pressure. The same participants felt that combining medicinal plants and prescribed Western medications will better manage their blood pressure. Furthermore, as a precautionary measure, a few participants reported taking medicinal plants and western medications just if the medicinal plant does not work to lower their blood pressure. The following quotes by the participants are evidence of the statements above:

“No, I don't do that because it’s either one or the other. Can't do two because you will end up in problem. I prefer bush medicine, though.” **P4**

“I only take herbs. I do not take the medicines from the doctor at all. The herbs are natural, so they are much better. Once you take those, you don't need the other medications.” **P6**

“Not only that, I drink the sour sap leave drink because that works for me. I don't drink my medicines from the doctor because they make me feel bad.” **P11**

“No, I don't combine the herbs with western medicines. I have no need to. When I make my cat's claw in my liter bottle, it helps greatly, so I don't bother with western medicines.” **P16**

“No, I do not do that because I don't like natural with chemicals.” **P18**

“No, I don't use hospital drugs. One time I went, and they gave me the drugs, but I felt worse when I tried them, so I stopped. I only use herbs, and I am good. My body doesn't like hospital medications.” **P20**

“No, I do not take any other medication with the herbs because once you are taking herbs and take tablets, the herbs won't work the way it should, so I don't take any tablets.” **P23**

“I only take my Aspirin 81mg to help the blood circulate better. As for hypertension, I only use my soursop.” **P24**

“Yes, I do because that's what the doctor prescribed for me, and I didn't want to be non-compliant and have my blood pressure go high. I do not intend to stay on the medication; this is why I started the teas along with healthy eating

and exercise. I have dropped 25 pounds already, and my doctor says if I continue, I can be taken off the medication.” **P1**

“I still take my prescribed medication because I had a brother who had a severe stroke due to high blood pressure, and he had to be in a wheelchair for years before he died. I don't want the same to happen to me. It was sudden. I try to exercise, keep my weight down, take my medicines as prescribed, and also drink natural medicine - one that is safe to take with my medication.” **P3**

“I take both the herbs and the other medicines. I only took the other medicines for the diabetes, and I still got high blood pressure. So now I take both so that they will work better.” **P7**

“I still take my soursop leaf tea with my high blood pressure medicines. I find out that I do not need to take the same dose after my herbal treatment, even if the dose needs to be reduced. Even though I am still taking my herb and blood pressure medicines, I do not take them at the same hours. I still follow my doctor's instruction because I am just trying to see the effect of soursop.” **P21**

“Yes. I take the pills every day, but when I feel bad because my pressure is high, I drink the soursop tea too.” **P14**

A few participants in this phase of the study reported the concomitant use of indigenous and Western therapies. The wide acceptance and usage of indigenous remedies in different cultures provide a growing habit of concurrent herb-drug use, which raises the concern of pharmacokinetic interactions (Parvez and Rishi 2019:275). In many communities, administering medicinal plant extracts in combination with therapeutic drugs is common, raising the potential for herb-drug interactions. Furthermore, the rising interest in natural products for disease management has reawakened natural product research in drug discovery, necessitating pharmacokinetic studies of phytochemicals, including their potential for drug interactions (Parvez and Rishi 2019:275). Many indigenous therapies have shown promising potential, thereby establishing clear therapeutic use potentials. However, many of these indigenous products are yet to be scientifically tested, and a large portion of them are either not monitored or poorly monitored scientifically (Ekor 2014:117; Shaikh et al. 2020:1008). The lack of adequate knowledge of indigenous therapies, especially their pharmacokinetics and pharmacodynamics with existing Western medications and other food products, calls for caution and a more rational approach in their usage (Ekor 2014:117; Mphuthi 2015:212). Accordingly, the availability of Western medicines in the market follows rigorous laboratory and clinical investigations and goes through stringent regulatory scrutiny; the same cannot be said of indigenous therapies. A wide variety of acclaimed herbal therapies currently lack sufficient scientific data and information on such products' safety or efficacy (Parvez and Rishi, 2019:275). The concomitant use of Western medications and indigenous therapies reported in this phase of the study could result in drug-herb interactions that could result in clinical outcomes that are unwanted or toxic.

To make matters worse, most individuals consuming both Western and indigenous therapies do not provide vital documentation of such usage, thereby making clinical decisions on interactions difficult (Parvez and Rishi, 2019:275).

4.10 CONCLUSION

The hypertensive patients who participated in this phase of the study primarily reported medicinal plants as the indigenous therapies used to manage their hypertension. The plants reported were *soursop* (n=9), *moringa* (n=6), *garlic* (n=5), *lime* (n=3), *ginger* (n=2), *lemongrass* (n=2), *breadfruit* (n=2), *cat's claw seed* (n=1), *pineapple* (n=1), *annatto* (n=1), *bukut* (n=1), *serosi* (n=1), *trumpet leaves* (n=1), and *cinnamon* (n=1). Some of the participants reported a single medicinal plant, while others reported a combination of medicinal plants they used to manage their hypertension (Figure 5:1).

Most of the participants indicated that the knowledge of indigenous therapies was passed down from generation to generation. Similarly, the participants reported their sources about medicinal plants' knowledge to come from family members, community, practitioners, or other sources. In addition, for most of the participants, the duration of medicinal plant use for the management of hypertension was mostly dependent on the number of years diagnosed with hypertension. Whereas some of the participants did not specify the duration of usage, most participants reported short-term, medium-term, and long-term use of medicinal plants to manage hypertension.

Most participants reported leaves as the common part of the medicinal plant used to manage their hypertension. In addition to leaves, fruits, roots, seeds, stems, and whole herbs have been reported by a few participants as parts of plants used to manage their hypertension. Although no standardized method was reported by respondents, boiling medicinal plant parts was the commonly reported preparation method reported by hypertensive participants. In addition, most respondents in this survey reported the oral route as the primary route for medicinal plant intake.

Respondents took the medicinal preparations as decoctions, teas, juices, mixtures of boiled plant parts, or herbs to manage their hypertension. Half a glass to full glass of medicinal plant therapies is taken either once or twice per day, as reported by most participants. Some participants reported taking the therapy anytime and for the entire day.

Although many of the participants could not provide insight into the medicinal plant's biological activity for their hypertension, most of them reported lowering their blood pressure. Respondents go to the hospital to regularly check their blood pressure even though they were not taking their prescribed medications. Additionally, participants reported various durations of use and indicated that they had been drinking the treatment for different time lengths. Some participants mentioned that they had been drinking the herbs for as little as three months to more than ten years.

Although a few participants reported dizziness, stomach upset and burns, bad feeling, drop in blood pressure and sugar, most participants reported not experiencing side effects with the medicinal plants they were taking for their hypertension.

Finally, hypertensive participants in this phase of the study reported that most of the medicinal plants they used to manage their hypertension are found within the community, while a few will buy some of the ingredients in the market. Most participants reported that they did not spend any funds to purchase the therapies because they either grew them at home or were found within the community. Friends and family members also supply medicinal plants to their relatives at no cost. Some participants reported that when they do not have a supply, they buy from the market, and the cost is reported to be less than 50 Belizean dollars in a month. A few participants in this phase of the study reported the concomitant use of indigenous and Western therapies. The participants reported that combining both medicinal plants and prescribed Western medications will better manage their blood pressure.

The concomitant use of western medications and indigenous therapies reported in this phase of the study could result in drug-herb interactions resulting in beneficial clinical outcomes or unwanted toxic responses.

4.11 PART 2: VENDORS OF INDIGENOUS HYPERTENSIVE THERAPIES

This part of the study presents data collected and analyzed from the vendors/suppliers of indigenous therapies in Belize.

4.11.1 Introduction

Previously, in chapter three and earlier in this phase of the study, it was mentioned that two sets of data were qualitatively collected using interviews. One data set was collected from hypertensive patients who are users of indigenous therapies, and another set of data from indigenous therapies vendors. This second part of the qualitative study presents an analysis of interviews from vendors of indigenous therapies to gain a more in-depth insight into the different therapies, preparation methods, and possible ethnopharmacology of medicinal plants used to manage hypertension in Belize. The critical themes and sub-themes categories that emerged from the analysis of interviews are discussed in this section. The description is in regards to the research objectives and the reviewed literature.

4.12 DATA COLLECTION

Vendors for this phase of the study were identified using three methods. Vendors were identified from the indigenous vendor association, hypertensive patients using indigenous therapies, and finally, using the snowball effect from previously identified vendors. Appointments were made with vendors through phone calls to meet at a place convenient to them. Most meetings for the interviews were conducted at the vendor’s homes or business place, with a few at the market place where they sell medicinal plants to their clients. One-on-one, face-to-face interviews were conducted with the vendors by first explaining the study’s purpose and obtaining their consent before the interview sessions. Each interview session lasted approximately 15-40 minutes.

Field notes were taken, and records of observed non-verbal clues were also taken. Written notes on the information provided by the vendors' were given unique codes known only to the researcher to protect the participant’s privacy, anonymity, and confidentiality.

4.12.1 Data analysis and management

Data analysis for vendors was conducted in the same manner as in the previous section. As described earlier, the thematic analysis described by Vaismoradi and Snelgrove (2019:2) was used for data management and analysis of interviews conducted for part II of this phase. A theme was described as a thread of underlying meanings within similar pieces of data that can be combined to give the researcher answers to the study phenomenon (Vaismoradi and Snelgrove 2019:2). The results of 19 interviews conducted with vendors were transcribed using Microsoft Excel and loaded into QDA Miner Lite version 2.0.6 online software for coding. Miner Lite is free software that is easy to use, generates basic themes, and has capabilities for exporting tables to Microsoft Word or

Excel for further analysis. Miner Lite® has a limitation because it cannot generate smart charts, as done by other Microsoft Word and Excel applications. The tables were exported to word, and the Microsoft Word smart art was used to design the figures. The integrated themes and sub-themes generated were presented in narrative passages and used to summarize study findings on indigenous therapies used to manage hypertension in Belize. The input from the research supervisor was received, which allowed for fine-tuning of themes and sub-themes. Since the emphasis for this phase of the study was to explore a deeper understanding of how indigenous therapies are prepared, dosage, administration, and perceived efficacy, only the themes, and sub-themes that address these issues were presented. Other useful information from the themes and sub-themes are summarized and presented in Table 4.13 below.

4.13 PART 2: OBJECTIVES

- To identify indigenous remedies used by vendors in the management of hypertension.
- To describe the preparations, treatments, storage, and efficacy of indigenous therapies used by vendors in managing hypertension in Belize.

4.14 VENDORS' BIOGRAPHICAL PROFILE AND SUMMARIES OF RECOMMENDED THERAPIES FOR HYPERTENSION

The vendors for this phase of the study comprised 19 licensed vendors of indigenous therapies in Belize. Part of the emerged themes and subthemes analyzed from the interviews with 19 vendors are summarized and presented in Table 4.13. The main themes and sub-themes that addressed this phase of the study's significant objectives are also discussed and described below. Nine of the vendors were males, and 10 were females. The average age of practice as an indigenous therapist was approximately 30 years, with 66 years being the maximum age, while the minimum age was nine years. Most of the vendors learned about indigenous therapies from their ancestors, such as grandparents, parents, or older people in the community. Few vendors learned therapies from other indigenous healers and herbal books, while one vendor took college courses on indigenous medicines. A vast majority of the vendors either cultivate medicinal plants, obtain them from the forest, or purchase from the local market. The plant parts reported by the vendors for use in the preparation of therapy for hypertension were leaves, fruits, seeds, bark, and the calyx of flowers. Leaves were the most commonly used plant parts by most vendors, as shown in Table 4.13 below.

Furthermore, $100Bzd was reported by vendors as the highest cost of indigenous antihypertensive therapies. Some vendors only accepted donations for their services, while a few vendors reported charging a minimal fee to cover the therapy's cost of ingredients. In contrast, some vendors do not charge their clients for the services offered. Others charge a small fee of between $4 - 15 dollars. The recommended therapies and

Table 4.13 Vendor's biographical profile and summaries of the recommended therapy for hypertension.

Vendor	Gender	Number of years practicing as a vendor	Source of knowledge	Source of Indigenous therapies	Recommended therapy	Part of plant used for therapy	Shelf- life of Rx	Avg. cost of therapy (BZD)	Claim on therapy efficacy
P1	Male	26	Ancestors, from generation past	Grow in yard, source from wild and other vendors	Serosi, Lime leaves, Sage, Boldo, Soursop, Annatto, Bukut, Dandelion,	Leaves, bark, flowers	7days in fridge & away from light	$20	Control BP
P2	Male	10	Great grandmother, mother and family	Grow or obtain from a relative	3-step therapy: Cooling: Bukut, Serosi, garlic, coconut water Purge: Senna. Piss-a-bed Treatment: (Spanish9): Flax	Leaves, seeds, bulb,	12hrs	$6	Control BP

					seed, Rose Mary, Sesame seed, Senna, Neem leaves				
P3	Female	66	Father	Cultivate	Serosi, Bukut	Leaves	2 days in fridge	Donation	BP control
P4	Male	28	Old folks	Cultivate, Purchase and obtain from wild	Samento, Boldo & Annatto	Leaves	1yr uses citric acid to preserve	$100	Cure can be seen in months
P5	Female	From a child	Grandmother	Purchase from local market	Pineapple skin, Orange leaves, Soursop, Annatto	Leaves, skin	7 days in the fridge	Small fee for preparation	Control BP
P6	Female	30	Grandmother, Herbal books	Purchase from local market	Tumeric, garlic	Roots, Powder	Long time in fridge	$20	Control BP
P7	Female	26	college		Soursop, garlic	Leaves	1yr in fridge	$50	Control
P8	Female	9	An old person	Yard & market	Soursop, Noni, & moringa	Leaves & fruit	8 dsys in fridge	$15	Control BP

P9	Female	10	Old lady	Yard & market	Sorrel, Cats claw, Soursop, ginger	Seeds, leaves & calyx	As long as it's in the fridge	$4	Control BP
P10	Female	66	Parents	Cultivate & purchase from market	Carrots, celery, breadfruit, grapefruit, garlic & honey	Bark, leaves, roots	2 days	Receives donation	Control BP
P11	Female	30	grandmother & herbal books	Purchase from local market	Tumeric, garlic	Roots	3-5 days	$10	Control BP
P12	Male	21	College courses	Obtain from community	Soursop, ginger	Leaves	1yr in fridge	$100	Control BP
P13	Male	9	Grandfather	Obtain from the wild	Talawala, ginger	Roots	7 days in fridge	None	Control BP
P14	Male	35	Father	Did not mention	Moringa, lime fruit	Leaves, fruit	7 days	None	Control BP
P15	Male	37	Mother	Did not mention	John Elamah	Leaves	6mo in fridge	$15	Cures BP
P16	Female	60	Grandparents and	Purchase	Almonds	Leaves	3days in fridge	$5 per treatment	Control BP

			old people around						
P17	Male	20	Grandfather	Did not mention	Almonds	Leaves	3-5 days in fridge	$6 per liter	Control BP
P18	Male	13	Grandfather	Did not mention	Soursop	Leaves	5 days in fridge	$10 per ½ gallon	Control BP
P19	Female	40	Indigenous healer	Cultivate	Lemongrass	Leaves	Prepared fresh each day	Receives donation	Cure but + lifestyle modification

Based on the table above, some of the medicinal plants used for the treatment and management of hypertension were soursop, lemongrass, moringa, turmeric, garlic, ginger, Almonds, Serosi, Lime leaves, Sage, Boldo, Annatto, Bukut, and Dandelion. Leaves of the medicinal plants were the most part reported by the vendors.

4.15 EMERGING THEMES AND SUB-THEMES

Based on the data analyzed from interviews conducted with indigenous therapy vendors, the following themes and sub-themes developed are presented in Table 4.14 and discussed below:

Table 4.14 Themes and sub-themes that emerged during the analysis of interviews with vendors

	Themes	Sub-themes
1.	Indigenous therapies for hypertension	1.1 Recommended antihypertensive therapies 1.2 Preparation of therapies for hypertension 1.3 Treatment of hypertension
2.	Perceived efficacy of indigenous therapies	2.1 Proposed mechanism of action of indigenous therapies for hypertension

The above themes and sub-themes are discussed in the paragraphs that follow.

4.15.1 Theme 1: Indigenous therapies for hypertension

Since time immemorial, indigenous therapies have been used to treat many illnesses in many communities (Ekor 2014:117; Mphuthi 2015:214; Shaikh et al. 2020:1008). Despite this global popularity, indigenous therapies have not developed in the same way as Western medicines due to the lack of policies and procedures for testing their effectiveness (WHO 2019:83). Often, those trained in Western medicine have taken this to mean that indigenous therapies are not effective in treating diseases. However, the apparent absence of techniques for testing its effectiveness should not be seen as evidence of its ineffectiveness (WHO 2019:84). In many countries, society determines the effectiveness of these therapies based on the number of patients healed (WHO 2019:35).

While some healing aspects of indigenous medicine are not yet fully understood, many communities have faith in the efficacy of their therapeutic benefits because they are attuned to their culture and their beliefs (Ekor 2014:117). The analyzed results of interviews on vendors of indigenous therapies showed that the vendors are confident of their therapy to effectively lower, control, or even cure hypertension. The identified therapies, preparation methods, and how the therapies are used in managing hypertension are discussed and described below.

4.1.1.1 Subtheme 1.1: Recommended antihypertensive therapies

A summary of medicinal plants recommended by vendors for hypertension management is presented in Table 4.13 above. The therapies used by the vendors for hypertension included roots (carrots, turmeric, garlic, and Talawala), seeds (cats claw, flaxseed, and sesame seeds), fruits (lime, grape, pineapple, and noni), and leaves (bukut, John Elema, Hammonds, soursop, lemongrass, moringa, breadfruit tree leaves, celery, orange tree leaves, annatto, boldo, samento, serosi, rosemary, neem, lime tree leaves, sage, dandelion, and Senna), and flowers (sorrel calyx). In addition, honey was mentioned as a sweetener by one vendor, and coconut water as a cooling agent. Seven vendors mentioned soursop leaves as a remedy for hypertension, making soursop leaves the most common therapy reported by the vendors. Additionally, therapies mentioned more than once by the vendors included garlic (4), serosi (3), ginger (3), boldo (2), annatto (2), Hammonds (2), bukut (2), and turmeric (2). All other therapies were mentioned just once by the vendors, as summarized in Table 4.13 above. Some of the mentioned therapies are evident by the quotes of the vendors below:

> *"I recommend fresh soursop leaves and garlic."* **P7**
> *"I treat hypertension with soursop leaves, and it works."* **P12**
> *"I use soursop to treat my patients that have pressure."* **P18**
> *"I give people with pressure moringa leaves."* **P14**
> *"I will give my clients Hammonds leaves for their pressure."* **P17**
> *"I treat hypertension with turmeric and garlic."* **P11**

"………..for hypertension, I recommend the skin of the pineapple." **P5**
"I recommend carrots, celery, and honey to my patients for their pressure." **P10**
"I always recommend a mixture/combination of Samento, Boldo, and Annato for hypertension." **P4**
"I used serosi, lime tree leaves, sage, boldo, soursop, annatto, and bukut, but the main plant I use for hypertension is dandelion." **P1**

A single medicinal plant or a combination of two or more plants in managing hypertension has been reported. The variety of medicinal plants recommended by the vendors has been reported in similar studies elsewhere, hence confirming the results of the study's current phase (Malik et al., 2018:789; Mans et al., 2017a:1; Baharvand-Ahmadi et al. 2016:1; Boadu and Asase 2017:1). Although some of the reported medicinal plants have verifiable scientific evidence in terms of their pharmacological activity, many are still being studied, and information obtained from native users provides useful information for scientific research into such medicinal therapies. For instance, soursop (*Annona muricata L*.) leaves, which were mostly mentioned by vendors in this phase of the study, belong to the family *Annonaceae* and reported in some studies to be useful in managing a few ailments, including hypertension (Mans et al. 2017b:1). The medicinal plant contains bioactive ingredients such as alkaloids and essential oils. The fruit also contains vitamin B2, vitamin B1, and vitamin C (Moghadamtousi, Fadaeinasab, Nikzad, Mohan, Ali, and Kadir 2015:15625). Although no evidence has been shown for its anticancer activity, indigenous people consider the fruit an alternative to managing cancer (Tundis and Loizzo, 2017:30).

4.15.1.2 Subtheme 1.2: Preparation of indigenous therapies for hypertension

The vendors of indigenous therapies were asked how they prepare their therapies for the management of hypertension. The researcher documented two levels of preparation.

At least two vendors indicated that they would first “prepare or clean out the patients” before the hypertensive therapy, while other vendors simply give the therapy without patient preparation. The vendor’s quotes on how they prepare their patients and therapies are shown below:

Vendor 2, for instance, will first prepare his hypertensive patients as evidenced by the quote below:

> *“The treatment is given in three different stages and dosages. First, I prepare the patient by beginning with the ‘cooling’ given on week one, the ‘purge’ given on week two (2), and then treatment named ‘Spanish 9’ given after that. The cooling and purge are given as a single dose within a week interval. The Spanish nine is prepared by me the same day it will be taken by the patient. I prepare a fresh batch of the remedy in the morning time.”* **P2**

Vendor 14, on the other hand, recommends a “clean out” before the commencement of therapy, as evidenced by his quotes below:

> *“Before taking this treatment, one must have a “clean out.” For cleanout, I use Senna and salt in the morning. The patient must be active after a dose of Senna and salt, so the treatment can be effective, and drink plenty of water. Clean out must be done on a full moon for best results.”* **P14**

Other vendors, however did not describe patient preparation; instead, they described the preparation of the therapy for hypertension as evidenced by their quotes below:

> *You take a pinch full of the grinded John Elama and put it in one liter of water, and leave to soak for 5 to 10 minutes. After being prepared, you take one cup full every morning.”* **P15**
>
> *I prepared the soursop therapy by putting some dried soursop leaves into a cup containing boiled water. I allowed soaking for 10-15 min, strain, and ready to drink. It is simple.* **P12**

The Talawala herb has no bitter taste. It was removed from the stem. The root must be cleaned of all orange Hair-like covering. A 6-inch piece must be boiled only with purified water and 1L of purified water. Allowed to stand for an overnight (10h). Strain water from the residue of the root. Collect water and place in a glass container, placed in a refrigerator. **P13**

A few branches of moringa would be boiled in purified water with no sugar. One medium lime will be added after boiling if the person wants a bit of flavor. The boiled mixtures would let sit overnight (10h). The mixture would then be strained, and pure boiled water was collected. The pure boiled water was placed in a glass container and refrigerated while drinking. The number of leaves needed to prepare a treatment. **P14**

A handful of fresh lemongrass was prepared every day. All fresh. You can get the grass from me, but only one week of supply at a time, or you can grow your own at home, even better. The lemongrass is boiled with 2-3 cups of water and drank as tea. **P19**

Well, turmeric can be prepared using different methods. One of the ways is by using the root that I usually recommend. The root can be boiled until the color of turmeric is gone, then allowed to cool, and you can strain it and use drink the boiled water. However, you can also buy the turmeric powder form and boil it. Garlic can be sprinkled on food, eaten raw, or swallowed. **P11**

Two vendors who recommended Hammonds leaves differ in their preparation methods. One vendor recommended that fresh leaves of Hammonds be soaked in water for about 10 min, while the other vendor recommended that the leaves be boiled for approximately 20-30 minutes, as evidenced by their direct quotes below:

About three fresh leaves of Hammonds are soaked in 1L of water for about 10 min transferred into a mug, and drink a cupful every morning. **P16**

Boil five leaves of Hammonds in a small pot of water on a low heat for about 20 - 30minutes. Let it cool, stain, and then store in the fridge for use. **P17**

The vendors reported a variety of methods for preparing therapies for hypertension. Most of the vendors prepare their antihypertensive therapies by decoction or infusion of the medicinal plant part. Boiling (decoction) and infusion have been reported as a common medicinal plant preparation (Busia 2016:14). The result seen in this study resonates with similar studies that reported decoction and infusion as the common method of medicinal plant preparation (Busia 2016:14; Malik et al. 2018:789; Baharvand-Ahmadi et al. 2016:1; Boadu and Asase 2017:1). Differences in preparation methods were also observed among vendors. Moreover, reports from indigenous therapy vendors showed diversity in water quantity and the length of time to boil the therapy. The lack of standard preparation methods for medicinal therapies for hypertension seen in this phase of the study is a general problem that has been reported in other studies (Evans-Anfom, 1986:13; Boadu and Asase 2017:1). The lack of standardization methods, sometimes even from the same healer, is a major source of concern with indigenous therapies (Boadu and Asase, 2017:1). The implication of a lack of standardization in preparing medicinal therapies means variations in dosage, potency, and efficacy could be experienced by clients even from the same vendor (Baharvand-Ahmadi et al. 2016:1; Boadu and Asase, 2017:1).

In addition to the lack of standardization in preparation methods, vendors reported differences in the shelf-life of the prepared therapies for use in hypertension, as evidenced by the quotes below:

> *"The lemongrass is to be prepared fresh every day."* **P19**
>
> *"I usually recommend that it is freshly prepared, or a small amount prepared, and you keep it refrigerated for about three days."* **P16**
>
> *"The shelf life is twelve hours because I do not add any preservatives to my therapies."* **P2**
>
> *"I add citric acid as a preservative. So it can last for about a year."* **P4**
>
> *"It is good for about five days if you keep it cool in the refrigerator; otherwise, three days."* **P17**
>
> *"Shelf life of the product after soaking is maximum of seven (7) days. All products should be kept in a cool place and away from direct sunlight."* **P1**
>
> *"I usually recommend like about six months when refrigerated."* **P15**

“It can be stored up to one year if you store it in a fresh condition and keep it refrigerated.” **P12**

The vendors of indigenous therapies reported that therapies could be prepared fresh each day and last for between 12 hours and up a year if properly refrigerated. Differences in the shelf-life observed in this phase of the research are an additional challenge for indigenous therapies globally (Ekor 2014:117; WHO 2019:16; Shaikh et al. 2020:1008). The differences in standard methods of preparing indigenous therapies compromise their safety, especially that there is a general lack of standard quality control, information for patients, and appropriate labeling of the active ingredients found in the indigenous therapies (Ekor 2014:117; Shaikh et al. 2020:1008). Recognizing these concerns inspired the World Health Organization to partner with different countries and researchers to provide the traditional medicine manual as a guide to practitioners and patients in the use of medicinal plants (WHO, 2019:12). As a country, Belize is yet to sign up partnerships with WHO, especially that not many studies have been conducted in the country to support the partnership. This study’s final report will provide baseline data for future studies on medicinal plants and other indigenous remedies found in Belize.

4.15.1.3 Subtheme 1.3: Treatment of hypertension

The use of indigenous therapies for the management of various diseases is a deep-rooted tradition in many cultures, and Belize is not an exception (Ekor 2014:117; WHO 2019:1; Shaikh et al. 2020:1008). In Belize, medications given at government hospitals, inclusive of antihypertensive medications, are usually free. Patients are only asked to purchase drugs from pharmaceutical stores when they are not available in a government facility. Despite the free and easily accessible medications at government facilities, the deep-rooted culture of indigenous therapies was noted in this study since the practice has not extinct. The indigenous therapies vendors reported various medicinal plants they used in the management of hypertension, as evidenced by the quotes below:

Vendor two gave a detailed treatment recipe as follows:

> *"First, I give them bukut, serosi, garlic, and coconut water for cooling. After a week, I give Senna (piss-a-bed) for the purge. Finally, I treat hypertension with Spanish 9. Spanish 9 is a special remedy that I prepare. It is a combination of flaxseed, Rose Mary, Sesame seed, Senna, and neem leaves."* **P2**

Other vendors are quoted as evidenced below:

> *"I mix the breadfruit leaves and serosi in bottles already for people to drink. The bottles are 1L and the person drinks like ¼- ½ cup about two to three times daily."* **P3**
>
> *"Well, I have a remedy that I prepare and is in this bottle. It is a mixture/combination of samento, boldo, and annatto leaves. I give my clients to use for their hypertension."* **P4**
>
> *"I give my patients boiled soursop leaves to drink 1 cup 3 times a day before meals and at bedtime."* **P7**
>
> *"One cup of boiled moringa and soursop leaves can be taken every night."* **P8**
>
> *"My product is already prepared, and customers are given 1L bottle, and they are to take ½ glass three times a day."* **P10**
>
> *"Four teaspoonfuls of the boiled soursop leaves were mixed with one cup of boiling water three times a day."* **P12**
>
> *"With Talawala, the hypertensive patient will drink 4 ounces after meals twice daily. Mild hypertensive patients and stressed hypertensive patients: drink 4 ounces once daily."* **P13**
>
> *"The patient will consume 4 ounces of moringa tea once daily. Then, the dose is reduced as per the patient's response. Before bedtime, one glass of water at room temperature."* **P14**
>
> *"Drink one cup full of the Hammonds tea every morning."* **P17**
>
> *"The freshly prepared lemongrass is to be taken - one cup of hot tea two times a day."* **P19**

Most of the vendors have a ready-made packaged therapy for hypertension to sell or provide to their clients. The therapy is either a single medicinal plant or a combination of plants. The treatment is made up of either a single or a combination of medicinal plants. Most vendors indicated ¼ cup to full cup of the treatment once, twice, or three times per day. A few recommended the treatment to be taken before bedtime. Specifically, vendors gave quantifiable indications of the amount of treatment to be taken by the clients. As observed earlier, the vendors reported no standardized therapy regimen in this phase of the study, even though vendors seem to be confident of the therapy's ability to lower and control hypertension. Many widely used medicinal therapies have great potential and abilities in treating or managing some diseases; however, many are yet to be tested and their use standardized for public consumption (Ekor 2014:117; Shaikh et al. 2020:1008). The promising possibilities of plants as a continual source for new drugs discovery is still being documented (Sharifi-Rad, Salehi, Stojanović-Radić, Fokou, Sharifi-Rad, Mahady, Sharifi-Rad, Masjedi, Lawal, Ayatollahi, Masjedi, Sharifi-Rad, Setzer, Sharifi-Rad, Kobarfard, Rahman, Choudhary, Ata, and Iriti 2017:1), and current studies are showing increased in demand and use of indigenous therapies in the treatment and management of various diseases (Ekor 2014:117; Malik et al. 2018:789; Baharvand-Ahmadi et al. 2016:1; Boadu and Asase, 2017:1). This increased demand for indigenous therapies is not unrelated to their perceived safety, availability, and affordability (Ekor 2014:117; Shaikh et al. 2020:1008). The World Health Organization recently reported that approximately 80% of people in both developing and developed countries rely on alternative herbal therapies to treat various ailments (WHO 2019:23). Despite their promising potentials, many challenges have been reported with indigenous therapies. For instance, their rational use is hampered by inadequate knowledge of their safety and adverse effects (WHO 2019:14; Shaikh et al. 2020:1008). Also, the lack of standard methods of indigenous therapies for the treatment of diseases as seen in this phase of the study is a general problem that has been reported in the literature (Evans-Anfom 1986:12; Boadu and Asase, 2017:1). The full potentials of indigenous therapies can only be fully maximized when standard methods of preparation, therapy, and adverse effects are fully understood.

Another challenge noted with the vendors is the combinational therapies with medicinal plants. It is a common practice for two or more medications to be prescribed to patients with western medicines, especially in the management of infections such as tuberculosis, Acquired Immune Deficiency Syndrome (AIDS), and chronic diseases like hypertension and diabetes mellitus type-2 (Dookeeram et al. 2017:1119). The combinational therapies with Western medications are deliberately designed to achieve additional therapeutic benefits (Dookeeram et al. 2017:1119). The combinational therapy with medicinal plants however is not without concerns. For instance, various interactions can occur between medicinal plants' components leading to complications (Che, Wang, Chow, and Lam 2013:5125). The often complicated and unpredictable herb-herb interactions can lead to severe detrimental consequences even though combinational therapy's intended desire was to enhance the therapeutic effect (Kahraman et al. 2020:1). The herb-herb interactions are usually due to the lack of understanding of active ingredients found in these herbs and the molecular mechanisms behind their bioactive properties (Che et al. 2013:5125). Furthermore, the lack of preclinical and clinical studies on medicinal plants' safety and efficacy makes their combination another major concern. However, because indigenous therapies evolved over the years have shown many combinatorial therapies (Che et al. 2013:5125), the practice reported by the vendors in this phase of the study was not without credibility given the historic combinational use of indigenous therapies.

4.15.1.4 Theme 2: Perceived efficacy of indigenous therapies

The perceived efficacy, safety, availability, and affordability of indigenous therapies have been reported to be the main reasons for their continual patronage (Ekor 2014:117; WHO 2019:12; Shaikh et al. 2020:1008). In this phase of the study, most indigenous therapy vendors reported alleged efficacies in their antihypertensive therapies to lower, control, or even out-rightly cure hypertension. This claim is evidenced by their comments as quoted and summarized in Figure 4.23 below:

Some vendors who indicated control or lowering of hypertension with their therapies

> *No, but it controls the pressure but cannot say it cures.* **P10**
>
> *Turmeric and garlic usually control blood pressure.* **P11**

No, my therapy does not cure hypertension, but it keeps it under control. **P14**
This lowers the pressure, so it no high again. **P17**
The herb helps to lower the pressure. **P18**
I am sure that my remedy controls the patient's hypertension. **P2**
The herb does not cure hypertension; it only regulates it and lowers it along with management and lifestyle changes. **P3**

A few of the vendors, however, lay claim that their therapies cures hypertension, as shown by the quotes below:

It will cure hypertension once you take it as long as possible and follow the instructions. **P12**
It will cure hypertension, especially if you take it every day, and you also need to do other things like do not put on weight and eat more green vegetables like chaya, callaloo, chib, and others. **P20**
This remedy will cure high blood pressure, and you will see the results in about 2 weeks' time. **P15**
It will cure hypertension once it is taken according to instruction and as long as possible. **P7**

Few vendors claimed if the therapies are taken, it will eliminate the need for prescribed Western medications, as evidenced by the quotes below:

It lowers the pressure. Since it is taken every day, there is no need to continue taking pills for high blood pressure. **P5**
As far as I know, turmeric and garlic only control blood pressure, but they eliminate the need for medications. **P6**
It controls blood pressure to the point that the patient does not need Western medication. **P13**

One vendor confessed that the therapies could control blood pressure, but he had no documentation to prove as evidenced by the quote below:

> *My blood pressure therapy controls hypertension only, however, there is no documentation to prove the success of the remedy. I am sure that the patients have their blood pressure under control.* **P10**

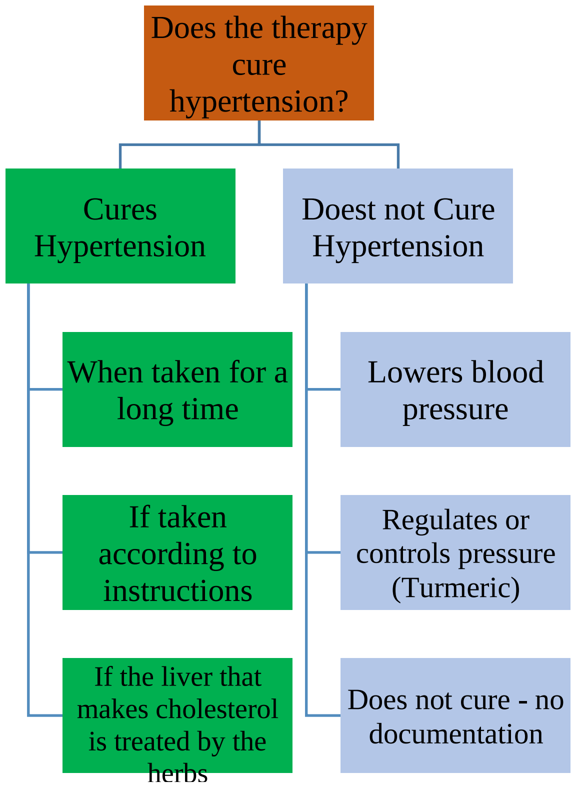

Figure 4.23 Reported efficacy of medicinal plants in the management of hypertension

The lowering of blood pressure abilities of many medicinal plants has been well described and documented (Al Disi et al. 2016:1; Malik et al. 2018:789; Baharvand-Ahmadi et al. 2016:1; Boadu and Asase 2017:1; WHO, 2019:16; Maresa et al. 2017:1). In this phase of the study, most indigenous therapy vendors reported a lowering or control of blood pressure with their therapies. These results resonate with previous studies and reports on medicinal plants' therapeutic benefits to lower or reduce blood pressure (Malik et al., 2018:789; Baharvand-Ahmadi et al. 2016:1; Boadu and Asase 2017:1; Mans et al.

2017a:1). Some vendors claim that their therapies can cure hypertension calls for further investigation because, presently, there is no known scientific report on medicinal or western medication that cures primary hypertension. Involvement of genetic, dietary, nonspecific lifestyle, stress, and family history are usually associated with primary hypertension's etiology (Bakris 2016:1). Presently, the management of primary hypertension involves lifestyle modification, the Dietary Approaches to Stop Hypertension (DASH), and the use of prescribed Western medications (Bakris 2016:1). The claim by some of the vendors to cure hypertension is presently contrary to available scientific evidence and medical practice, as such needs additional research and exploration.

The lack of standardization reported with indigenous therapies is common in many communities. Although there is a lack of sufficient knowledge of these therapies, they have always served as useful guides for identifying and discovering new drugs (Ekor 2014:117; Shaikh et al. 2020:1008). This study is a judicious approach in documenting baseline information for future research in Belize.

Concerning the concomitant use of indigenous therapies with western medications, vendors were asked if their clients could combine them with prescribed western medications. The analyzed responses of vendors are evidenced by the quotes below:

> *"No, they cannot take with it other medicines because the herb will not work how it's supposed to."* **P15**
>
> *"The mixture helps the patient to get well and does not interfere with western medications because I ask my patients to stop taking White man medicine when they are on my therapy."* **P5**
>
> *"Yes, they can take with it other medicines."* **P14, P16**
>
> *"Yes, yes, they can take with their medications. It is safe."* **P17, P19.**

Not many vendors responded to the question on the concomitant use of medicinal plants with prescribed Western antihypertensive medications. The few vendors that responded had conflicting recommendations to their clients. Some vendors believe that the remedies should not be combined with Western medications, while a few vendors indicated that the therapies could be combined. The natives have used these therapies for an extended period and may imply a certain level of perceived safety by the vendors. This is a common belief in many cultures that use indigenous therapies. For instance, in countries like Brazil and the European Union (EU), traditional medicines are generally acceptable, and because they have a recognized efficacy are considered a special category of drugs called traditional herbal medicine products (THMP). These special categories of drugs have less rigorous requirements in terms of non-clinical and clinical studies (Moreira, Moreira, Teixeira, Monteiro, De-Oliveira, Ana, and Paumgartten 2014:248). The THMP's are considered generally acceptable when they have reported long-standing use as herbal therapies and if there is evidence of their safety (Moreira et al. 2014:248). The use of medicinal plants reported for the management of hypertension should still be done with caution since, historically, herbal therapies have been shown to have mild to grave adverse effects (Ekor 2014:117; Shaikh et al. 2020:1008; Kahraman et al. 2020:1).

4.15.1.5 Subtheme 2.1: Proposed mechanism of action of indigenous therapies for hypertension

Vendors of indigenous therapies were asked how their therapies work to lower or control blood pressure, and the quotes below evidenced some of their responses:

> *"Hammonds tree leaves clean out the kidney and make you urine out a lot just like the high blood pressure medicine pills."* **P17**
>
> *"It cleans the body out, especially the kidneys that make blood pressure high."* **P16**
>
> *"Lemongrass cleans the liver and takes out the fat and purifies the blood that's why the person urinates a lot."* **P19**
>
> *"The samento builds up the immune system, the annatto lowers pressure, makes you urine a lot, so it's good for enlarged prostate too, and the boldo is a detoxicant of the liver and blood. So these jungle medicines work by treating the liver that makes the cholesterol."* **P4**
>
> *"The pineapple skin tea cleans the kidneys. By keeping the kidney clean, all the toxins are removed from the body, and therefore the blood is clean, so the blood pressure does not go up. It also cleans the body of the bad fat. It also makes the patient pee very often."* **P5**

"John Elama leaves cleans all the toxins and impurities from the body, especially from the blood, which flows through the body. If the blood is sick, then the person will be sick too. Once the person is ok, then everything will be ok. It is just a balance." **P15**

The summary of the vendor's responses is also captured in Figure 4.24 below:

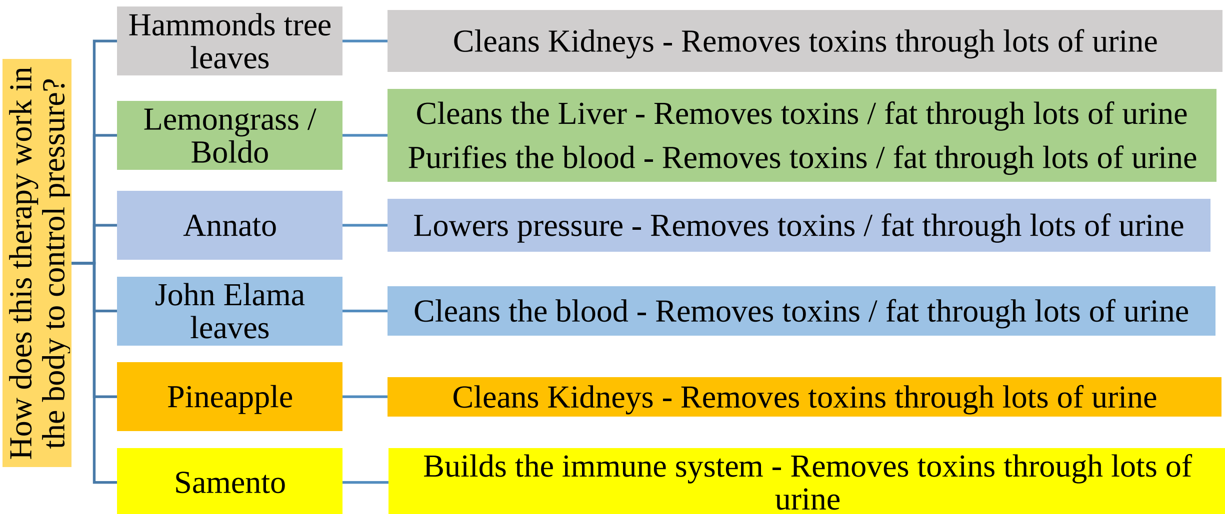

Figure 4.24. How indigenous antihypertensive therapies work

The vendors proposed a few mechanisms of action for recommended medicinal plants. The mechanism of action included antioxidant activity, antidiuretics, hypolipidemic, and immunomodulatory activity. The general mechanisms of action attributed to many medicinal plants used in managing hypertension have been reported and are briefly discussed here for some of the medicinal plants mentioned by the vendors.

4.15.1.6 Soursop (Annona muricata) [Linnaeus]

Soursop was the major mentioned medicinal plant for hypertension management by the vendors. Their claims are not without significant support from scientific studies. For instance, in a controlled randomized trial with 143 human subjects, Alatas, Sja'bani, Mustofa, Mukti, Bawazier, Irijanto, Zulaela, and Tomino (2017:223) investigated the effects of soursop supplements on blood pressure and serum uric acid. They reported a reduction in both hypertension and serum uric acid among the study subjects. Additionally, antagonism of Ca^{2+} leading to vasodilation and a reduction in blood pressure have been reported with leaf extract of soursop (Nwokocha, Owu, Gordon, Thaxter, McCalla, and Ozolua 2012:1436). These studies gave preclinical indications of the efficacy of soursop in the management of hypertension. Similar studies have indicated the indigenous use of soursop to reduce hypertension (Nwokocha et al. 2012:1436; Mans et al. 2017a:1). Inconclusive reports of atypical Parkinsonism have been linked to soursop when large quantities of the extracts are taken (Lannuzel and Ruberg 2008:2122). The adverse effects associated with soursop are directly connected to inhibition of mitochondrial complex I of annonamine and annonacin, which are potent neurotoxins found in soursop (Lannuzel and Ruberg 2008:2122).

4.15.1.7 Tumeric (Curcuma longa) [Zingiberaceae]

Tumeric is a spice used for cosmetics, cooking, medicines, and dyes. As a food additive, it gives color and flavor to food. More than 100 compounds have been identified in turmeric, including curcuminoids, polysaccharides, volatile oils, and turmerone, arturmerone, and zingiberene responsible for the aroma in turmeric (Prasad and Aggarwal 2011:13). The active component found in turmeric is curcumin (Qin, Huang, and Gong 2017:68). Curcumin has further been reported to lower serum lipids and decreases oxidative stress in the process, acting as a cardioprotective agent (Li, Ding, Li, Xu, Yang, Bi, and Wang 2015:1; Maithilikarpagaselvi, Sridhar, Swaminathan, Sripradha, and Badhe 2016:1; Pulido-Moran, Moreno-Fernandez, Ramirez-Tortosa, and Ramirez-Tortosa 2016:1). The mention of turmeric by the vendors; therefore, as an indigenous therapy for hypertension, is not without scientific backing. Turmeric and its compounds have no known toxicity to humans and animals. The United States Food and Drug Administration (USFDA) has been conducted clinical trials on turmeric and reported that it is generally safe (Prasad and Aggarwal, 2011:13).

4.15.1.8 Moringa (Moringa oleifera) [Moringaceae]

A few vendors mentioned moringa as a medicinal plant that they recommend to their clients for hypertension. The anticancer, lipid-lowering, antioxidant, and antidiabetic effects of moringa extracts have been reported (Gonzalez-Trujano, Martinez-Gonzalez, FloresCarrillo, Luna-Nophal, Contreras-Murillo, and MagdalenoMadrigal 2018:1; Vergara-Jimenez et al. 2019:2). In addition, extracts of moringa leaves have been shown to produce anti-inflammatory, diuretic, and antihypertensive activities (Chatterjee, Anantharaya, Singhal, Chatterjee, Shiva, and Mallya 2016:119). Furthermore, moringa contains vitamins, phytochemicals such as carotene, and minerals (Haseeb, Sarkhil, Fayazuddin, and Ahmad 2019:767). The numerous pharmacologic activities of moringa are still being evaluated for both preclinical and clinical trials, but their use as antihypertensive agents, as seen in this phase of the study, resonates with previous studies done elsewhere on moringa (Adefegha, Oboh, Iyoha, and Oyagbemi 2019:1; Gbankoto, Sindete, Adjagba, Sangare, Attakpa, and Awede 2019:1257; Vergara-Jimenez, Almatrafi, and Fernandez 2019:2).

4.15.1.9 Roselle (Hibiscus sabdariffa) [Malvaceae]

Roselle, a popular beverage in Africa, Caribean, and Europe, has been indicated as a medicinal plant by the vendors. Roselle’s blood pressure-lowering activities have been extensively studied and reported both in humans and animals (Onyenekwe et al. 1999:199; Herrera-Arellano et al. 2004:375, 2007:6; Mojiminiyi et al. 2007:292; Mozaffari-Khosravi et al. 2009:48; Inuwa et al. 2012:563; Hopkins et al. 2013:84; Islam 2019:14). Consequently, different mechanisms for Roselle’s antihypertensive effect have been reported (Islam 2019:14). The vasorelaxant pathways of both VSMCs (Ali et al. 2005:369; Ajay et al. 2007:388) and endothelial cells (Ajay et al. 2007:388; Herrera-Arellano et al. 2007:6) are primed by Roselle. Inhibition of Ca^{2+} channels (Ajay et al. 2007:388), the opening of KATP channels (Sarr et al. 2009:45), and increased production of NO (Ajay et al. 2007:388; Alarcon-Alonso et al. 2012:751) are various mediated pathways of Roselle’s relaxant effect. Roselle has also been reported to decrease heart rates in rats (Odigie et al., 2003:181) and inhibit cardiac hypertrophy (Odigie et al. 2003:181; Inuwa et al. 2012:563). Additionally, Roselle's diuretic abilities (Onyenekwe et al. 1999:199; Ali et al. 2005:369; Herrera-Arellano et al., 2007:6; Alarcon-Alonso et al. 2012:751; Jalalyazdi et al. 2019:107), its ability to lower uric acid concentration (Ali et al. 2005:365) and decrease in the blood sodium content of stage 1 and 2 hypertensive humans (Herrera-Arellano et al. 2007:6) have all been described. The flavonoid and phenolic compounds found in the roselle calyces, such as chlorogenic acids, anthocynins, quercetin, and kaempferol are mainly responsible for the hypotensive effect roselle (Okereke, Iroka, and Chukwuma 2015:16).

4.15.1.10 Lemongrass (Cymbopogon **andropogoneae/*citratus) [Poaceae]***

As noted earlier in this report, the vendors mentioned lemongrass for hypertension management. Interestingly, lemongrass has been reported to exhibit antihypertensive properties attributed to its active phytochemicals, especially citral (Devi et al. 2011:143, 2012:539475; Unuigbe et al. 2019:1). The antihypertensive effects of lemongrass, its relaxant properties, and its effects in rats have previously been extensively described (Devi et al. 2011:143, 2012:539475; Bastos et al. 2010:331). Additionally, Dzeufiet, Mogueo, Bilanda, Aboubakar, Tédong, Dimo, and Kamtchouing (2014:507) evaluated the effect of fresh lemongrass extracts on ethanol - and sucrose-induced hypertension in rats. The results of their study showed a reduction in blood pressure in rats through the improvement of biochemical indices such as kidneys, vascular endothelium, and oxidative status signifying lemongrass therapeutic potentials for hypertension (Dzeufiet et al. (2014:507). In a recent human study, a significant increase in urine frequency, volume, and urinary electrolytes was also reported when lemongrass was administered to human participants compared to the control group indicating the diuretic properties of lemongrass (Ekpenyong, 2018).

4.15.1.11 Celery (Apium graveolens) [Umbellifers]

The vendors also mentioned celery as a therapy for hypertension. Reported studies on celery showed an active ingredient called N-butylphthalide, which gives celery an aromatic odor and flavor and has been reported to lower blood pressure in animal models (Tsi and Tan, 1997:34; Dianat et al. 2015:12; Tashakori-Sabzevar et al. 2016:619). Aortic ring contractions caused by cumulative calcium increases in high potassium (60mM) due to blocking Ca^{2+} influx via calcium channels have also been shown to be a property of apigenin, which is a flavone isolate of A. graveolens (Ko, Huang, and Teng 1991:1). Additionally, this medicinal plant can reduce oxidative stress by its flavonoid content that potentiates antioxidant mechanisms (Popovic et al. 2006:1; Dianat et al. 2015:1; Tashakori-Sabzevar et al. 2016:619).

4.15.1.12 Cerasee (Momordica charantia) [Cucurbitaceae]

Cerasee (*Momordica charantia*) is another medicinal plant identified by indigenous therapy vendors to manage hypertension. The leaves and fruits of cerasee are rich in phytochemicals and have been reported in indigenous folk therapies for managing cancers, diabetes, high blood pressure, and various viral and bacterial infections (Polito, Bortolotti, Maiello, Battelli, and Bolognesi 2016a:1). Cerasee contains five major phytochemicals, which include terpenoids and saponins (cucurbitacines and cucurbitanes), heteropolysaccharides (such as mannose, rhamnose, glucose, galactose, and arabinose), phenols and flavonoids, peptides and proteins (such as mormorcharins and momordins), and other fatty acids, sterols, essential oils and amino acids (Dandawate, Subramaniam, Padhye, and Anant 2016:81). The pharmacological activity attributed to cerasee is its antioxidant and anti-inflammatory properties (Dandawate et al. 2016:81). Currently, no sufficient data exist on the adverse effects of cerasee; however, Raman and Lau (1996:349) reported that ceracee should be avoided in an allergy to Cucurbitaceae families and individuals with glucose-6-phosphate dehydrogenase deficiency because of the risk of developing favism. Other adverse effects include reduced fertility (Stepka, Wilson, and Madge 1974:645), pregnancy (Basch, Gabardi, and

Ulbricht 2003:356), risk of kidney toxicity (Mardani, Nasri, Hajian, Ahmadi, Kazemi, and Rafieian-Kopaei 2014:35), and possible acute intestinal nephritis (Beniwal, Gaur, Singh, Raveendran, and Malhotra 2017:456).

4.15.1.13 Neem (Azadirachta indica) [Meliaceae]

Neem's mention by the vendors has some historical and indigenous significance in that neem trees have been reported to be used to manage many illnesses. For instance, Alzohairy (2016:1) reported that the activities of neem include but are not limited to antidiabetic, antimalarial, antifungal, antioxidant, and antinephrotoxicity, anticancer, antiviral, and anti-inflammatory activities. The most important active ingredient found in need is azadirachtin. Others include salannin, nimbidol, nimbolinin, nimbin, gedunin, nimbidin, ascorbic acid, nimbiol, quertin, nimbanene, 7-desacetyl-7-benzoylgedunin, n-hexacosanol, 6-desacetylnimbinene, nimbolide, 17-hydroxyazadiradione, polyphenolic flavonoids, β-sitosterol, and sodium nimbinate (Djibril, Mamadou, Gérard, Geuye, Oumar, and Rigal 2015:52; Alzohairy 2016:1). Possible mechanisms of action for hypertension have been reported to antioxidant activity due to scavenging free radicals (Alzohairy 2016:1), and a combination of Ca2+, NO-inhibition, and a possible negative inotropic activity of the heart (Shah, Gilani, Hanif, Ahmad, Khalid, and Bukhari 2014:418).

4.15.1.14 Pineapple (Ananas comosus) [Bromeliaceae]

Pineapple skin (peel) is one of the recommended therapies that vendors gave their clients to manage hypertension. Bromelain is the name of the pineapple fruit extract and is found in high concentrations in the pineapple stem. Bromelain contains carbohydrates, cellulases, phosphatases, glycoproteins, thiol endopeptidases, and some protease inhibitors (Pavan, Jain, Shraddha, and Kumar 2012:1). Furthermore, bromelain has been reported to have some therapeutic effects, including improving angina pectoris, reversing platelet aggregation inhibition, thrombophlebitis, and enhancing the absorption of many drugs (Pavan et al. 2012:1). The pharmacologic benefits of bromelain in hypertension are not very clear but are thought to breakdown cholesterol, thereby improving arterial and general cardiovascular function (Pavan et al., 2012).

4.15.1.15 Boldo (Peumus Molina) [Monimiaceae]

The vendors also identified boldo as one of the medicinal plants used for the management of hypertension. Lau, Ling, Murugan, and Mustafa (2015:522), in a recent review, reported that Boldine [(S)-2,9-dihydroxy-1,10-dimethoxy-aporphine] is a potent antioxidant that contains aporphine alkaloids and exhibits some health benefits such as antitumor, cytoprotective, anti-inflammatory, and antidiabetic activities. This review further describes the attributed mechanism of boldine action to its ability to reduce oxidative stress due to its antioxidant properties. Additionally, the phenolic compounds found in boldine have been reported to have potential in controlling the pathogenesis of chronic diseases that result from oxidative stress, maintain physiological homeostasis, and scavenge oxygen and nitrogen reactive species (Forni, Braglia, Mulinacci, Urbani, Ronci, Gismondi, Tabolacci, Provenzano, Lentini, and Beninati 2014:1255; Impei, Gismondi, Canuti, and Canini 2015:1526; Gómez and Velarde 2018:3). Low toxicity with boldine has also been reported (Lau et al. 2015:522).

4.15.1.16 Annatto (Bixa orellana) [Bixaceae]

The vendors identified annatto leaf extracts as one of the medicinal plants recommended for hypertension. The crude pigment extract of Bixa orellana L. is called Annatto, contains norbixin, bixin, and carotenoids (Raddatz-Mota, Pérez-Flores, Carrari, Mendoza-Espinoza, de León-Sánchez, Pinzón-López, Godoy-Hernández, and Rivera-Cabrera 2017:1729). The presence of salicylic acid, tomentosic acid, bixaghanene, phenylalanine, crocetin, ellagic acid, saponins, flavonoid bisulfates, bixol, isobixin, bixein, threonine, sterols, tryptophan, and tannins have been revealed from phytochemical studies of Bixa Orellana leaves (Venugopalan, Giridhar, and Ravishankar 2011:9). The antioxidant properties of boldine are attributed to stereoisomers of vitamin E, tocotrienols, and tocopherols (Patacsil, Tran, Cho, Suy, Saenz, Malyukova, Ressom, Collins, Clarke, and Kumar 2012:93). Boiled extracts of boldine leaves have been reported for use in managing hypertension, obesity, vomiting, prostate disorders, heartburn, urinary disorders, hypercholesterolemia, nausea, diuretic, renal insufficiency, and as a laxative (Raddatz-Mota et al. 2017:1729).

4.15.1.17 Trumpet tree (Cecropia peltata) [Cecropiaceae]

The widespread use of trumpet tree for treating hypertension and type 2 diabetes mellitus has been reported (Salas, Brenes, and Morales 1987:127; Andrade-Cetto, Cárdenas, and Ramírez-Reyes 2007:203). The therapeutic effects of trumpet tree have been associated with triterpernoids, phenolic acids, chlorogenic acids, and flavone C-glycoside, such as isovitexin, isoorientin, orientin and vitexin (Costa, Schenkel, and Reginatto 2011:913; Ortmann, Réus, Ignácio, Abelaira, Titus, de Carvalho, Arent, Dos Santos, Matias, Martins, de Campos, Petronilho, Teixeira, Morais, Streck, Quevedo, and Reginatto 2016:469; Rivera-Mondragon, Bijttebier, Tuenter, Custers, Ortíz, Pieters, Caballero-George, Apers, and Foubert 2019:1). The medicinal befits of leaf extracts of the trumpet tree have been reported to include treatment of respiratory diseases, inflammation, hypertension, malaria, and diabetes mellitus type 2 (Rivera-Mondragon, Ortíz, Bijttebier, Vlietinck, Apers, Pieters, and Caballero-George 2017:1500).

4.15.1.18 Cat's Claw – [Uña de Gato] (Uncaria tomentosa) [Rubiaceae]

The phytochemicals found in *Uncaria tomentosa* include alkaloids, polyphenols, quinovic acid glycosides, and the plant has been used as an anti-gastric ulcer, anti-inflammatory, antiviral, anti-arthritic, and to reduce the adverse effects of chemotherapy (Araujo, Feitosa, Murata, Furigo, Teixeira, Lucena, and Carvalho 2018:1). Reduced lipid concentration and insulin sensitivity improvement have been reported in rats with *U. tomentosa* (Araujo et al. 2018:1). The phytochemicals reported in *U. tomentosa* include sterols, flavonoids, oxindole alkaloids (such as mitraphylline, isopteropodine, isomitraphylline, pteropodine, and uncarine F.), polyphenols, polyhydroxylated triterpenes, catechin tannins, and quinovic acid glycosides (Kemper, 1999:4). *U. tomentosa's* antihypertensive activities were reported to be associated with its antioxidant activity. Blockage of voltage-gated calcium channels, and negative inotropic activity on the heart, hypolipidemic, and vasodilation due to inhibition of the sympathetic nervous system have been reported (Kemper 1999:5). Although no updated scientific information was found on *U. tomentosa's* toxicity, Kemper (1999:9) earlier in a review reported clinical data to show hypotension, sedation, slight diarrhea, and possible renal failure. The medicinal plant is traditionally contraindicated in children less than three years, pregnancy, and lactation (Kemper 1999:4).

4.15.1.19 Breadfruit (Artocarpus altilis) [Moraceae]

Artocarpus altilis has been used in folk medicine to manage high blood pressure and has been reported to contain phytochemicals such as essential oils, valine, phenylalanine, isoleucine, and leucine (Liu, Ragone, and Murch 2015:847). Many identified compounds of *A. altilis* demonstrate antifungal activity, antitumor properties, inhibition of platelet aggregation, and antibacterial activity (Mukesh, Boey, Kumutha, Bavani, Ling, and Kaveti 2014:091). Breadfruit extracts have also been reported to lower mean arterial blood pressure in mice by enhanced nitric oxide production and reduced angiotensin-mediated mean arterial blood pressure (Christian, Jackson, and Mukhopadhyaya 2019:4). Similarly, Nwokocha et al. (2012:1096) reported hypotensive effects of *A. altilis* due to negative chronotropic activity, antagonism of Ca2+ channels, and alpha peripheral sympathetic activity.

4.15.1.20 Ginger (Zingiber officinale) [Zingiberaceae]

Ginger has been reported to reduce blood pressure mainly from its bioactive constituents, namely (6)-gingerol and (6)-shogoal (Khan, Ullah, and Azhar 2019:125). Liu and Huang (2016:1) reported (6)-gingerol as a potent angiotensin II type 1 receptor blocker. Inhibition of angiotensin-converting enzyme (ACE) and lipid peroxidation in hearts of rats has been demonstrated (Akinyemi et al. 2013:641). Potent scavenging of oxidant molecules like peroxynitrite has been reported with zingerone, another active compound found in ginger (Shin et al. 2005:7617; Khan et al. 2019:4). Akinyemi et al. (2014:317) recently reported ginger inhibition of ACE-1 activity while reducing LDL levels, total cholesterol, vLDL, and triglycerides.

4.15.1.21 Garlic (Allium sativum) [Amaryllidaceae]

Garlic has been reported for its anti-inflammatory, hypocholesterolemic, anti-cancer, antibacterial, hypotensive and antioxidant properties, and its healing abilities have been reported in various cultures and societies for over a thousand years (Chan et al. 2020:3). The significant bioactive organo-sulfur substances reported in garlic are diallyl disulfides (DADS), methyl thiosulfonate, S-allyl cysteine (SAC), diallyl trisulfides (DATS) and Allicin (Qidwai and Ashfaq 2013:12), produce its unique mechanisms of action. Various garlic types have been reported to lower systolic, diastolic, or both blood pressure in extensive reviews (Banerjee et al. 2002:4; Chan et al. 2020:3). In the same vein, garlic was reported (Qidwai and Ashfaq 2013:12 Chan et al. 2020:3) to have an efficacy of almost 80% as an anti-hypertensive herb. Additionally, inhibition of vascular smooth muscle cell proliferation, reduction in angiotensin II-induced vasoconstrictor responses, abrogating activation of NF-κB, and inhibition of endothelin-1 induced vasoconstriction have all been reported with garlic (Banerjee et al. 2002:4; Castro et al. 2010:552; Pan et al. 2013: 627375).

4.15.1.22 Bukut (Cassia grandis) [Leguminosae]

The phytochemical studies of *C. grandis* revealed the medicinal plant to have potent purgative and laxative properties due to anthranoides (Lodha, Joshi, Vyas, Upadhye, Kirve, Salunke, Kadu, and Rogye 2010:330). The therapeutic effect of C. *grandis* was further reported by Lodha et al. (2010:330) to possess antidiabetic properties due to its effect on triglycerides, cholesterol, and glucose in rats. Although most of the scientific studies reviewed on *C. gradins* are in relation to its antidiabetic effects, its antioxidant properties may be a great potential in the management of hypertension (Prada, Keita, de Souza, Lima, Acho, da Silva, Carvalho, and Amado 2019:191; Sakharkar and Chauhan, 2017:295). The presence of flavonoid and phenolic compounds in *C. grandis* have been associated with its antioxidant and free radical scavenging properties (Umamaheswari and Chatterjee, 2007:61). Other reported therapeutic potentials of *C. grandis* include fever, indigestion, jaundice, bronchitis, gonorrhea, burns, nausea, and syphilis (Wasantwisut and Viriyapanich, 2003:60).

4.16 CONCLUSION

This study's qualitative phase revealed different medicinal plants used by both hypertensive patients and vendors of indigenous therapies interviewed. The various reasons for indigenous therapy use were connected to culture, availability, affordability, and perceived efficacy and safety of the indigenous therapies. The medicinal plants mentioned were carefully reviewed and compared with current scientific studies. Most of the claims made on the medicinal plants have verifiable scientific backing. Medicinal plants secondary metabolites were the basis for the pharmacological activity seen with many reported medicinal plants.

Secondary metabolites found in medicinal plants are the major therapeutic effects for hypertension and other diseases produced by the medicinal plants (Teixeira, dos Santos, and Citadini-Zanette, 2017:4). These secondary metabolite compounds synthesized and stored by the plants, which are major determinants of their bioactive and pharmacologic activities, were represented in this study phase. In a recent review, Teixeira et al. (2017:4) reported various pharmacological mechanisms of lowering hypertension by medicinal plants. These include weak diuretic effect and direct vasodilation activity (*Eugenia uniflora L*.), inhibition of calcium influx leading to decreased vascular resistance (*Cymbopogan citratus*), vasodilation through nitric oxide mediation and calcium channel blockade (*Panax ginseng*), diuresis and vasodilatory activity (*Allium sativum*), angiotensin-converting enzyme inhibition (*Crataegus laevigata*), and a combination of vasodilation, inhibition of calcium channels and diuresis.

A few vendors in this study also reported concurrent indigenous and western therapies usage and medicinal plants' combination. Also, even though a lack of standardization and quality control was noted with the medicinal preparations, dosage, and shelf-life, many of the reported medicinal plants did not present significant side-effects. The common side-effects reported were mild hypotension, heartburn, acid reflux, abdominal swelling, and flatulence, which resonates with the previous study of medicinal plants' side effects (Al Disi et al. 2016: 326).

CHAPTER 5

INTEGRATING THE RESEARCH FINDINGS AND DEVELOPMENT OF GUIDELINES

5.1 INTRODUCTION

In chapter four, data were obtained and analyzed both quantitatively and qualitatively. In the quantitative phase, a total of 422 participants were surveyed on indigenous-western therapies use from hypertensive patients in Belize utilizing a well-structured and verified questionnaire. Information collected from participants was grouped into demographic, Western medication, and indigenous therapy usage. Collected data were analyzed using SPSS version 22.0 software. Results are presented in frequency tables, graphs, and charts.

Furthermore, chapter four describes the detailed research analysis and results of the qualitative phase of the study. In the study's qualitative phase, two data sets were collected on indigenous-western therapies for treating hypertension using face-to-face interviews. Data set were collected from 24 patients diagnosed with hypertension using indigenous therapies or combined therapies to manage hypertension and 19 vendors of indigenous therapies in Belize. The themes and sub-themes categories that emerged from the analysis of interviews are described in detail in chapter four. Summaries of the analyses for both hypertensive patients and vendors are presented below.

5.2 MAIN FINDINGS OF QUANTITATIVE PHASE

Detailed results of the analysis of hypertensive patients were described in chapter four, and the summaries of the results are presented here. The data analyzed revealed the various medicinal plants used by indigenous people in the management of hypertension. Long before colonization, the indigenous people had ways of caring for the sick in a holistic manner, which involved the individual, family, community, and the environment (Mans et al. 2017a:1; 2017b).

Even though these holistic indigenous healthcare approaches were disrupted and not recognized by the colonial masters, the practice still exists and is widely accepted among indigenous people in Belize and many parts of the world (Mans et al., 2017a:1). Christian religious traditions and scientific knowledge have been widely attributed to the disruptions of indigenous knowledge systems. Despite these disruptions, indigenous practices are still mainstream healthcare in many communities with proven effectiveness (Mphuthi 2015:150). The summary of the main findings from the study's quantitative phase is presented in the following paragraphs.

The following main findings were derived from the quantitative data collected from diagnosed hypertensive patients in Belize. The quantitative data revealed that the indigenous hypertensive Belizeans have a wealth of knowledge on indigenous therapies used in managing hypertension that has been used by the communities long before colonization (Mans et al., 2017a:1).

5.2.1 Hypertension diagnosis and medication use

High blood pressure or hypertension is often called the "silent killer" because it frequently has no apparent symptoms. Metabolic disease has been reported to increase the risk of heart diseases such as heart attack, stroke, and other untoward conditions (Hypertension 2020:1). The majority of the respondents reported being diagnosed with hypertension within the last ten years. About 39.6% (n=167) were diagnosed in the last 1 to 5 years and had the highest reported hypertension diagnoses, while 27.7% (n=116) were diagnosed in the last 6 - 10 years. In order to prevent organ damage in patients diagnosed with hypertension, effective management of hypertension requires the timely clinical provision of balanced nonpharmacological and pharmacologic interventions (Rivera et al., 2019:97). The majority (n=173; 41.0%) of the participants reported being on westerns medications for 1-5 years, while 25.5% (n=107) reported using Western medications for 6 – 10years. The majority (n=335; 33.7%) of the respondents reported being on hydrochlorothiazide, with 12.3% (n=122) using captopril.

Regarding Western medication adherence, approximately 39.3% (n=166) of the respondents did not stop their medications, even when they felt their blood pressure was under control. The compliance with Western medication seen among respondents could be attributed to the single-dose regimen reported by the majority (83.6%; n=353) of the respondents. In addition, adherence to the medication regimen could be due to effective patient counseling by the pharmacist. Minimal adverse effects have been reported to improve Western medication adherence (Burnier & Egan, 2019:1124). Therefore, this study results indicate that most hypertensive participants adhered to their prescribed Western antihypertensive medications.

5.2.2 Use of indigenous therapies

Ever before the emergence of modern medicines, people used indigenous therapies to treat their diseases. Presently, over a hundred active compounds have been scientifically identified as drugs from plants alone (Helmenstine 2019:1). An increasing amount of literature exists on medicinal plants and herbs used for the management of hypertension. Some of the herbal therapies have gone through extensive studies with many reported discoveries about their bioactive metabolites, while others are still being studied, and new information on their pharmacology and toxicities has been revealed (Helmenstine 2019:1). In this study's quantitative phase, questions on indigenous therapies used to manage hypertension, and how they were prepared were asked the respondents. Data analyzed showed that respondents reported over 30 medicinal plants as available indigenous therapies used to manage hypertension. Beetroot (n=56; 13.3%), garlic (n=45; 10.7%), and *aloe vera* (n=27; 6.4%) were among the highest reported indigenous therapies used by the public for the management of hypertension. Respondents also reported Garlic (*Allium sativum*) [n=225; 70.9%], Lime (*Citrus aurantiifolia*) [n=105; 32.8%], and Aloe vera (*Aloe barbadensis miller*) [24.4% n=78] as the most common indigenous therapies used for the management of their hypertension. Furthermore, the primary sources of indigenous therapies reported by respondents were yard/family/friends (n=94; 22.3%) and indigenous therapy vendors/markets (n=69; 16.3%).

A combination of leaves, roots, seeds or bark (n=161; 38.2%) and leaves (n=64; 15.2%) were majorly reported as the parts used for hypertension therapy (Figure 5:1 below). In this phase of the study, medicinal plants were the only indigenous therapies reported by the participants for managing hypertension, with approximately 55% (n=232) of respondents using medicinal plant therapies to manage their hypertension. Approximately 20.1% (n=85) reported having consumed indigenous therapy for their hypertension more than five times in 12 months. 13.5% (n=57) reported consuming the therapies more than five times per week, while 10.2% (n=43) reported taking indigenous therapies for their hypertension every day in the past 12months.

Numerous factors have led to a substantial global increase in medicinal herb usage. Foremost among them is that herbal remedies are inexpensive compared to conventional drugs and have fewer adverse effects. The World Health Organization (2019:4) reported that this increase in patronizing herbal remedies is not necessarily dependent on the country, region or economic status or the individuals since complementary and alternative medicines are now used by over 70% of people in developed countries for the prevention or treatment of various ailments and diseases. The trend is not any less in developing countries where a more pronounced usage of alternative medicines is being recorded (WHO 2019:4; Ekor 2014:117).

5.2.3 Indigenous therapies with western medications.

Regarding concomitant medication use, a common practice with indigenous therapy is polypharmacy. Polypharmacy uses more than one drug or substance for therapy (Burt et al. 2018:2). This practice is monitored in the clinical setting using carefully designed paper-based or computer software. Although it is much easier to monitor the possibilities of drug-drug interactions in the clinical setting, monitoring for indigenous-western drug interactions is difficult because these interactions have not been scientifically extensively studied. There are many uncharacterized compounds in medicinal plants that present many opportunities for drug-herb or herb-herb interactions.

These drug-herb or herb–herb interactions can precipitate toxic effects or, in some instances, render the therapeutic effect of a conventional drug or the more promising herbal preparation (Mans et al., 2017a:1).

The respondents in this study reported a combination of indigenous therapies used to manage hypertension with prescribed western antihypertensive medications. About 29.4% (n=124) of the respondents reported combining indigenous therapies with prescribed Western antihypertensive medications to manage their hypertension. The major reason for combining indigenous therapies with western medications was that the combination was more effective in managing hypertension (28.3%; n=119) and lower blood pressure faster (38.8%; n=164).

Furthermore, the majority (n=149; 35.3%) of respondents reported not informing their medical practitioners about using indigenous therapy to manage their hypertension, and 21.3% (n=90) did not give a reason for not informing their medical practitioners about indigenous therapy consumption for the management of their hypertension.

Religion, cultural beliefs, the cost of those herbs, and the perceived efficacy of indigenous therapies informs the patient's choice to use indigenous medicines (Ekor 2014:177). These herbs are readily available and cheap, making them the first line of treatment in many communities.

5.3 MAIN POINTS OF THE QUALITATIVE PHASE (PART ONE, MEDICINAL PLANTS USERS).

Although the use of medicinal therapies in many communities is rising and gaining wide acceptance globally, many countries are yet to embrace the benefits derived from them. Rigorous regulative obligations make it challenging and difficult for herbal medications to be registered. Therefore, the stringent regulatory requirements in such countries limit the opportunity for the use of medicinal therapies.

For instance, herbal medicines in the United Kingdom have been viewed with reservation and seen suspiciously as therapies that are likely to cause peculiar health challenges to the public's generality of health. Because of this perception, many consultations between indigenous medicine practitioners and physicians are being conducted to ensure public safety while being careful not to deny the benefits derived from such therapies (Walker, 2015:1; Boyle et al., 2011:951). In this qualitative section, summaries of analyzed data and discussed results on medicinal plants, prescription, dosage, and administration routes from hypertensive patients in the qualitative phase are presented.

The hypertensive patients who participated in this phase of the study primarily reported medicinal plants as the indigenous therapies used to manage their hypertension. The plants reported were *soursop* (n=9), *moringa* (n=6), *garlic* (n=5), *lime* (n=3), *ginger* (n=2), *lemongrass* (n=2), *breadfruit* (n=2), *Cat's claw seed* (n=1), *pineapple* (n=1), *annatto* (n=1), *bukut* (n=1), *Serosi* (n=1), *trumpet leaves* (n=1), and *cinnamon* (n=1). Some reported a single medicinal plant, while others reported a combination of medicinal plants they used to manage their hypertension (Figure 5:1 below).

Most of the participants indicated that the knowledge of indigenous therapies was passed down from generation to generation. Similarly, the participants reported their knowledge about the medicinal plant to come from family members, community, practitioners, or other sources. Furthermore, most of the participant's duration of medicinal plant use for managing hypertension was mostly dependent on the number of years diagnosed with hypertension. Whereas some of the participants did not specify the duration of usage, most participants reported short-term, medium-term, and long-term use of medicinal plants to manage their condition (hypertension).

Furthermore, most participants reported leaves as a common part of the medicinal plant used to manage their hypertension. In addition to leaves, fruits, roots, seeds, stems, and whole herbs have been reported by a few participants as parts of plants used to manage their hypertension. Although participants reported no standardized method, medicinal plant parts' boiling was the commonly reported method of preparation reported by hypertensive participants. Furthermore, most participants in this study reported the oral route as the primary route for medicinal plant administration. Participants take medicinal preparations as decoctions, teas, juices, mixtures of boiled plant parts, or herbs to manage their hypertension. In addition, respondents reported taking between half a glass to full glass of medicinal plant therapies are taken either once or twice per day, as reported by most participants. Some participants reported taking medicinal plant therapy anytime and for the entire day.

Although some of the participants were not able to provide insight into the biological activity of the medicinal plant they used for their hypertension, the majority of them reported a lowering of their blood pressure, as evidenced by the fact that some of them go to the hospital to regularly check their blood pressure just to verify the effectiveness of indigenous therapy. Additionally, participants reported various durations of medicinal plant use and indicated that they had been drinking preparations from medicinal plants for different lengths of time. Some participants mentioned that they have been drinking the therapies for three months to ten years. Although a few participants reported dizziness, stomach upset and heartburn, bad feeling, drop in blood pressure and sugar, most participants reported not experiencing side effects with the medicinal plants they were taking for their hypertension. In essence, this experience can infer that medicinal plants' use is safer in side effects.

Finally, hypertensive participants in this phase of the study reported that most of the medicinal plants they use to manage their hypertension are found within the community, while a few will buy some of the ingredients in the market for the preparation of therapy. Most participants reported that they did not spend any funds to purchase the therapies because they either grew them at home or were found within the community. Friends and family members also supplied medicinal plants to their relatives at no cost. Some participants reported that when they did not have a supply, they buy from the market, and the cost is reported to be less than 50 Belizean dollars in a month. The concurrent use of indigenous and western therapies was reported by a few participants in this phase of the study. These participants believed that combining medicinal plants and prescribed

Western medications will help manage their blood pressure better. The concurrent use of Western medications and indigenous therapies reported in this phase of the study could lead to drug-herb interactions. The interactions could result in better hypertension management or pronounced adverse. Few adverse effects were reported by the participants designating indigenous therapies safe for public health. Further research is envisaged in this field.

5.4 MAIN POINTS OF QUALITATIVE ANALYSIS WITH VENDORS (PART TWO)

The importance and usefulness of indigenous therapies cannot be overemphasized. The practice has been recognized, approved, and encouraged by the World Health Organization (WHO 2019:11). The WHO's recognition of indigenous medicine could only span from the therapy's effectiveness, and historically, long before the WHO's declarations, many indigenous populations have used indigenous therapies to treat their ailments. Participants in this study gave examples of how their recommended therapies improved the health conditions of their clients.

In this section, summaries of analyzed and discussed results from vendors of hypertensive therapies are presented. The main themes and sub-themes that addressed this phase of the study's major objectives are also discussed and described below. A total of nine (47.4%) vendors were males, while 10 (52.6%) were females. Most participants reported practicing as an indigenous therapist for a minimum of nine years, with the maximum years of practice being 66. Most of the vendors reported medicinal plants as the indigenous therapies used to manage hypertension, and most of them learned about indigenous therapies from their ancestors, such as grandparents, parents, or older people in the community.

A few vendors reported learning about indigenous therapies from traditional healers and herbal books. Only one vendor took college courses on indigenous medicines. A vast majority of the vendors either cultivate the medicinal plants, obtain them from the forest or purchase from the local market. The plant parts reported by the vendors for use in the preparation of therapy for hypertension were leaves, fruits, seeds, bark, and the calyx of flowers. Leaves were the commonly used plant part by most vendors, the same as reported by the users. Furthermore, $100 was reported by vendors as the highest cost of indigenous antihypertensive therapies when buying them from the market. Some vendors only accept donations for their services, while some reported charging a minimal fee to cover the therapy's cost of ingredients. Some vendors charged a small fee of between $4 - $15 Belize dollars.

The therapies used by the vendors for hypertension included roots (carrots, turmeric, garlic, ginger, and Talawala), seeds (*cats claw, flaxseed, and sesame seeds*), fruits (*lime, grape, pineapple, and noni*), and leaves (*bukut, John Elema, Hammonds, soursop, lemongrass, moringa, breadfruit tree leaves, celery, orange tree leaves, Annatto, Boldo, samento, serosi, rosemary, neem, lime tree leaves, sage, dandelion, and senna*), and flowers (*sorrel calyx*) [Fig. 5.1 below]. Also, honey was mentioned as a sweetener by one vendor and coconut water as a '*cooling agent*.' Seven vendors mentioned soursop leaves as a therapy for hypertension, making soursop leaves the common therapy reported by the vendors. Additionally, therapies mentioned more than once by the vendors included garlic (4), ginger (3), *serosi* (3), *Boldo* (2), *Annato* (2), *Hammonds* (2), *Bukut* (2), and *Tumeric* (2). All other therapies were mentioned just once by the vendors. The vendors recommended a single medicinal plant or a combination of two or more plants to manage hypertension. In regards to medicinal plant preparation, two levels of preparation were documented by the researcher. Two vendors indicated that they would first *prepare* or *clean out* the patients before the actual hypertensive therapy commencement, while other vendors simply gave the therapy without patient preparation. In addition, most of the vendors prepared their antihypertensive therapies by decoction or infusion of the medicinal plant.

Similarly, differences in preparation methods were also observed among vendors. Additionally, the indigenous therapy vendors' report showed diversity in water quantity and time to boil the therapy.

Regarding medicinal plants' packaging, most of the vendors have a ready-made packaged therapy for hypertension to sell or provide to their clients. The treatment is made up of either single or a combination of medicinal plants. Most vendors indicated ¼ cup to full cup of the treatment once, twice, or three times in a day. A few recommended the treatment to be taken before bedtime. The lack of standard indigenous therapies for treating diseases was seen in this phase of the study.

A few vendors responded to the question on concomitant use of medicinal plants with prescribed western antihypertensive medications. The few vendors that responded had conflicting recommendations for their clients. Some vendors recommend medicinal plants to be taken with western medications, while other vendors did not. In this phase of the study, most indigenous therapy vendors reported alleged efficacies in their antihypertensive therapies to lower, control, or even out-rightly cure hypertension. Some vendors claim their therapies cure hypertension, contrary to available scientific evidence and medical practice. Such claims call for additional research in exploring the bioactive ingredients and mechanism by which they cure hypertension. Finally, few mechanisms of action for recommended medicinal plants were proposed by the vendors. These mechanisms of action included antioxidant activity, antidiuretic, hypolipidemic, and immunomodulation activity. Generally, mechanisms of actions attributed to many medicinal plants used in managing hypertension have been reported and discussed in chapter four. Guidelines on indigenous therapies are discussed in this chapter based on the information gathered from both the study's quantitative and qualitative phases.

Fig. 5.1 List of medicinal plants for the management of hypertension mentioned by participants in both ph

5.5 INTEGRATION OF THE FINDINGS FROM THIS RESEARCH

The mixed-methods methodology research with the multiphase design described by Cresswell (2015:67) was followed to provide a baseline level data in the use of indigenous-western antihypertensive therapies in the country of Belize. Data generated from both quantitative and qualitative phases were mixed to provide detailed guidelines on the use of indigenous-western therapies as reported by both hypertensive patients and vendors of indigenous therapies. The data collection procedure followed an explanatory sequential mixed method design. The triangulation principle was used to combine the quantitative and qualitative data that aided in developing the guidelines.

Creswell & Plano-Clark (2018:54) described an explanatory sequential mixed method design consisting of first collecting quantitative data and then collecting qualitative data to explain or elaborate on the quantitative results. This approach's rationale was that the quantitative data provided a general overview of the research problem, while the qualitative data collection was needed to refine, extend, or explain the general picture. In this method, Creswell (2015:542) further classified three ways how the data from an explanatory sequential method can be mixed.

First, the quantitative data (QUAN) collection and analysis were given by introducing it first in the study and representing a significant data collection aspect. A small qualitative (QUAL) component typically followed in the second phase of the research. Second, quantitative data was collected in the sequence followed by the secondary qualitative data collection. This approach was presented in two phases, with each phase identified in headings on the report. Third, the qualitative data was used to refine the results from the quantitative data. This refinement results in exploring a few typical cases, probing a key result in more detail, or following up with an outline.

The merging or mixing of the data was done by triangulation. Creswell (2015:542) described triangulation "as a means that investigators could improve their inquiries by collecting and integrating different kinds of data bearing on the same phenomenon." The three points to the triangle are the two sources of the data and the phenomenon. This improvement in inquiries would come from blending the strengths of one type of method and neutralizing the weaknesses of the other. This study adapted the triangulation principles to combine the quantitative data with the qualitative data to produce the guidelines on indigenous – western antihypertensive therapies in Belize. Such guidelines included parts of the plants used for hypertensive management, how to process the indigenous therapy, the recommended dosage, how the remedy should be taken, and reported adverse effects or interactions when used with western medicines.

Finally, the WHO Handbook for guidelines development was followed in ensuring standardization in the development of the guidelines (WHO 2019:6). The WHO handbook provided detailed help for a transparent decision-making process and a high-quality methodology for using systematic strategies in developing guidelines (WHO 2019:2). The minimum reporting standards were also provided, inclusive of information dissemination of developed guidelines. The handbook recommendations were followed in the development of indigenous-western therapies guidelines.

The WHO consolidated type guideline was chosen for the development of indigenous-western therapies guidelines. The consolidated guidelines are also referred to as a compilation of guidelines. It provided the flexibility to form guidelines in line with previous guidelines that are already in existence. However, such guidelines are expected to be complex because the updated information and recommendations are required. However, since this is the first attempt to document and provide guidelines for indigenous-western hypertensives, it is only proper to consider the consolidated guidelines. Standard guidelines are usually applied to clinical or policy areas, while interim guidelines are only produced when WHO is asked to provide such guidelines based on data completion and availability. Since indigenous-western hypertensive guidelines were not in response to an emergency or rapid response, WHO guidelines will be inappropriate and not suited for this purpose (WHO 2014:8).

However, in following the WHO guidelines, first, the PICO (Population, Intervention [or exposure], Comparison and Outcomes) model was applied and modified for this study as a framework that provided the effectiveness of the indigenous intervention as compared with western therapies (WHO 2014:79).

P (Population)	Hypertensive patients and indigenous medicines vendors
I (intervention)	The concurrent use of both indigenous-western therapies for hypertension
C (comparison)	How many people are using these therapies as single or combination
O (outcome of interest)	Reduced or lowered blood pressure and guidelines for indigenous therapy use for hypertension.

Table 5.1: PICO table used to describe the development of guidelines (Source: WHO 2014:8)

5.5.1 Population – Taylor (2020:1) described the population as the participants of a particular study. He further explained that everyone or everything included as the subject of a statistical observation could be considered the population. In this study, the population comprises diagnosed hypertensive patients and vendors of indigenous therapies in Belize. Trends, patterns, and behaviors are observed from a statistical population as individuals interact with clearly defined interventions used to draw conclusions (Taylor 2020:1). The detailed sampling technique, sample, and sampling size for quantitative and qualitative populations were described in chapter three.

5.5.2 Intervention – An active (e.g., drugs) or non-active (e.g., placebo) but specified treatment applied to a population is referred to as intervention (Glen 2019:1). Additionally, intervention has been defined as the action or process to address an issue to find outcomes (Creswell 2015:73; WHO 2014:80). In the present study, the use of indigenous-western therapies for managing hypertension by the Belizean populace was considered the intervention.

5.5.3 Comparison – Comparison is used when two or more items or people are evaluated to determine similar and relevant characteristics (Merriam-Webster's Collegiate Dictionary, 1999). In this study, the number of people using indigenous–western therapies was evaluated. The study further assessed whether the participants use single or combination of both indigenous–western therapies to manage hypertension. The outcomes of the comparison for both indigenous and western therapies were used to develop guidelines as described by WHO (WHO, 2014:180).

5.5.4 Outcomes – An outcome is described as any possible result seen in a trial or an experiment (Home statistics libreTexts 2019:1). The outcomes for the study were reduced blood pressure from either single or combinatorial indigenous–western therapies. These outcomes were used to develop the guidelines in line with WHO protocols (WHO 2014:81).

5.6 GUIDELINES ON THE USE OF INDIGENOUS-WESTERN ANTIHYPERTENSIVE THERAPIES

Guidelines on the use of indigenous-western anti-hypertensive therapies developed are presented here based on the data collected and literature reviewed. In line with the WHO guidelines on acceptable herbal processing practices for herbal medicines and documentation of all procedures that depict the safety and quality of indigenous medicines, especially herbal therapies, were made (WHO 2019:102). The guidelines provided in the current study are in line with the WHO recommendations to document indigenous therapies studied here to manage hypertension. Furthermore, the World Health Organization recommended the inclusion of the information below as part of the documentation process (WHO 2019:102). The information on medicinal plants reported here was also compared with reported research and WHO monographs on medicinal plants (WHO 2011:1). The guidelines were summarized and presented in tabular form for comprehension, as shown in Table 5.2 below. Reported doses and routes are from the research participants, while other information such as active ingredients found in medicinal plants, mechanisms of action, interactions, and toxicities were from literature.

Table 5. 2 Guidelines on medicinal plants used for the management of hypertension in Belize

Plant botanical and Belizean local name (Plant family)	Part of plant used for HTN	Method of Preparation	Recommended dose/ route of admin	Medicinal activity	Reported active ingredient	Presumed mechanism of action	Reported toxicity	Interaction with western medicines	References
Aloe Vera [*Aloe barbadensis miller]* (Asphodelaceae)	Leaves	Pressed to obtain juice from gel	Oral/ half to full cup daily. Orally	Anti-infective, laxative, antioxidant	vitamins, enzymes, minerals, sugars, lignin, saponins, salicylic acids and amino acids	- Interacts with growth hormone to stimulate proliferation - Inhibits the COX pathway to reduce PGE2	Hepatitis, abdominal cramps, Allergic reactions, diarrhea, laxatives, consti	Decreases the effectiveness of digoxin & digitoxin, increase potassium depletion when used with furosemide, hypoglyc	Surjushe et al. 2008

						production - Alprogen inhibits calcium influx leading to the inhibition of histamine & leukotriene - Stimulates fibroblast	pation,	emia with insulin	
Almond tree [*Termialia catapp]*	Fresh leaves	Infusion	1-3 cups, 1-3 times	antimicrobial, antidiabetic, antioxidant,	phenol, flavonoid, carotenoi	strong scavenging	None reported.		Anand et al. 2015;

(Rosaceae)			daily. Orally	hepatoprotective, anticancer, dermatitis, hepatitis, inflammatory disease, diabetes	d, triterpenoid, steroid, saponin, tannin,	activity on reactive oxygen species	Broad margin of safety		Kalita et al. 2018
Annatto [*Bixa orellana]* (Bixaceae)	Leaves	Infusion	Oral / 1-3 cups daily. Orally	Diarrhea, diuretic, hypertension, obesity, vomiting, heartburn, urinary tract disorders, nausea, laxative, Anti-inflammatory, Anticonvulsants, prostate disorders,	norbixin, bixin, carotenoids, salicylic acid, tomentosic acid, bixaghanene, phenylalanine, crocetin, ellagic acid,	Antioxidant	Hypoglycemia	May cause hypoglycemia with Insulin	Raddatz-Mota et al. 2017

				urinary disorders,	saponins, flavonoid bisulfates, bixol, isobixin, bixein, threonine, sterols, tryptophan, and tannins				
Avocado tree [*Persea americana]* (Lauraceae)	leaves, root, bark, fruit, seed	Infusion	Half to full cup daily. Orally	lipid-lowering, antihypertensive, antidiabetic, anti-obesity, antithrombotic, antiatherosclerotic, and cardioprotective menorrhagia, hypertension,	alkanols, terenoid glycosides, terpenoid glycosides ,flavonoids, persin, coumarin,	Inhibition of Ca^{2+} mobilization through voltage-dependent channels, Promote healthy	cardiac arrhytmias, myocardial necrosis and mastitis in	Induced cytochrome P-450	Tabeshpour et al. 2017

				stomach ache, bronchitis, diarrhea, diabetes, parasites, hypertension, fever, cough, cold	scopoletin	lipids, may interfere with GABAergic action and/or neurotransmission	mammals & birds		
Bay leaf [*Laurus nobilis]* (Lauraceae)	leaves	infusion	1 – 3 cups in a day. Orally	Antiviral, analgesic, anti-inflammatory, antimutagenic, anticonvulsant, antioxidant,	Tannins, flavones, flavonoids, alkaloids, eugenol, linalool, methyl chavicol, anthocyanins.	free radical scavenging, hydrogen peroxide scavenging, superoxide anion radical scavenging,	Generally safe. No safety information in pregnancy & breast	Slow CNS with anesthetic during surgery	Batool et al. 2020

							feeding.		
Beetroot [*Beta vulgaris]* (Chenopodiaceae)	Roots	Juice	1-2 cups daily. Orally	Hypertension, heart diseases, diabetes, constipation, decreased libido, gut and joint pain, fever, psychiatric problems, dandruff.	Flavonoids, vitamins, minerals, amino acids, betalains, polyphenols, saponins, inorganic NO_3	Antioxidant effect through reduction of oxidative stress, improve endothelial function, and dramatically increase the plasma NO2 level and systemic	Well tolerated, Benign Beeturia,	Inhibits COX2, Interacts with caffeine, creatinine, β-alanine, and sodium bicarbonate,	Hamedi, 2019; Mirmiran et al. 2020

						NO production			
Boldo [*Peumus Molina]* (Monimiaceae)	Leaves	Infusion	Taken as tea. 1-3 cups 3 times daily. Orally	colagogue, antioxidant, anti-inflammatory, hepatoprotective, antimicrobial, antifungal, anthelmintic and diuretic actions	aporphine alkaloids and phenolic compounds, gallic acid, tannins and catechin-derived procyanidins	Antioxidant, trypanocidal activities, lower ACE-1 activity, inhibited the acetylcholine-induced contraction, induce Ca2+ release from the internal	No significant toxicity, Hypersensitivity to the active substance,	None reported	Mariano et al., 2019; Lau et al., 2015; de Souza et al. 2019

						Ca2+ storage site of skeletal muscle.			
Breadfruit tree [*Artocarpus altilis*] (Moraceae)	Leaves	Infusion	Oral/ 1-3 cups daily. Orally	Hypertension, antibacterial, antitubercular, antiviral, antifungal, antiplatelet, antiarthritic, tyrosinase inhibitory, cytotoxicity	Phenylpropanoids, phenolic compound, protein, carbohydrate, fat, calcium, phosphorus, iron, niacin, thiamine and vitamin	Scavenging activity, superoxide anion-scavenging activity, inhibition of alpha glucosidase enzyme, produces negative chronotropic and	No significant toxicity reported	inhibitions of cytochrome P450s (CYP3A4 and CYP2D6) enzyme activities	Christian et al., 2019; Liu et al., 2015

						hypotensive effects through α-adrenoceptor and Ca^{2+} channel antagonism.			
Bukut [*Cassia grandis]* (Leguminosae)	Pods	Pulp	Juice. Taken orally	Antidiabetic, hematinic, laxative,	Iron, saponins, porphyrins, flavonoids, tannins, phenols, essential oils, galactomannan,	Inhibits trypsin, inhibits alpha-glucosidase & pancreatic lipase, free radical scavenging	No significant toxicity reported	None reported	Prada et al. 2019; Fuentes et al. 2020

Calabash fruit [*Crescentia cujete]* (Cucurbitaceae Binoniaceae)	Pulp from fruits, leaves, seeds	Infusion, juice,	Taken as tea or juice. Orally	Diarrhea, colds, headaches, asthma, laxative, diarrhea, diuretic, cold, bronchitis, stomach aches, urethritis, cough, hypertension, infertility, cytotoxic, antivenom,	Plumieride, Naphtoquinones, asperuloside, iridoid glycosides, aucubin, tartaric acid, citric acid, estigmasterol, cianhidric, tannins, alpha and beta amirina, flavonoid	Antioxidant activity free radical scavenging properties. DPPH radical scavenging,	Conflicting reports. Fruits and seeds are poisonous	None reported	Das et al. 2014; Sagrin et al. 2019

					s, sugars, CNS depressant,				
Cat's Claw (Samento) [*Uncaria tomentosa]* (Rubiaceae)	Seed, leaves	Decoctions, infusions,	1-3 cups 3 times daily. Orally	anti-inflammatory, antitumor, GIT disorders, immunostimulant, antidiabetic, antimicrobial, antiparkinsons, epilepsy,	triterpenes, flavonoids, phenols, phenylpropanoids, indole alkaloids, campesterol, glycosides, triterpenes	Antioxidant: protect against oxidative stress, potent radical scavenging, superoxide radical scavenging activity, Ca^{2+} channel	nausea, acute renal failure, slow heart rate, stomach discomfort, hormonal effects, diarrhea,	Bleeding with warfarin, prevents the microsomal CYP 3A4 activity, and thus, increased the serum levels of drugs that are metabolized by	Batiha et al. 2020; Weiss 2018; Araujo et al. 2018

						blocker, diuretic	hepatotoxicity, decrease progesterone and estrogen levels, neuropathy, allergies,	CYP 3A4, hypotension when used with antihypertensive drugs, electrolyte imbalance with diuretics, interacts with hormonal drugs, & cholesterol lowering drugs. Bleeding	

								with aspirin & interacts with NSAIDs, contraindicated when immunosuppresant drugs	
Carrots [Daucus carota] *(*Apiaceae)	Roots	Eaten raw, mixed with food or taken as juice	1-3 cups 3 times daily. Orally	Anticancer, cardiovascular diseases, hypertension, anti-inflammatory, plasma lipid modification, and anti-tumor properties.	phenolics, carotenoids, polyacetylenes, and ascorbic acid,	Scavenging free radicals as an antioxidant, diuretics, hepatoprotective,	Mild allergies with leaves	None reported	Ahmad et al. 2019

Cascarilla [*Croton eluteria]* (Euphorbiaceae)	Bark, roots, seeds	Infusions, decoctions,	1-3 cups 3 times daily. Orally	Antihypertensive, anticancer, hypolipidemic, antiviral, antiestrogenic, cytotoxic, hypoglycemic, antimicrobial, antiinflammatory, antimalarial, antispasmodic, bronchitis,	Diterpenoids, alkaloids, tannins, volatile oils, flavonoids, cascarillin,	Antioxidant: free radical scavenging, Inhibits COX, smooth muscle relaxant, hypolipidemic,	None reported	None reported	Salatino et al. 2007
Celery [*Apium graveolens]* (Apiaceae)	Leaves	Used as vegetables salads	Taken with food	Hypertension, liver disease, menstrual disorders, respiratory diseases	Sedanolide, benzofuran 3-n-butylphthalide, steroids, phenols, carbohydrate,	Vasodilation, stimulation of muscarinic receptors, diuresis, antioxidant	Plant is generally safe; avoid use in pregnancy; cause	alter the pharmacokinetic of captopril	Siska et al. 2018; Kooti & Daraei 2017; Tashakori-Sabzevar et

					flavonoids		s allergy in some people		al. 2016; Dianat et al. 2015
Chestnut [*Pachira aquatica]* (Malvaceae)	Leaves, seed	Infusion, decoction,	Seeds eaten raw of fried, decoction taken as medicine. 1-2 cups 3 times daily. Orally	Fever, headaches, respiratory diseases, hepatitis, stomachaches, anemia, hypertension,	Neolignans, triterpenoids, Sesquiterpenoids, flavonoids, lignans,	hemagglutinating & trypsin inhibition	Seeds were toxic to rats	No information found	Cheng et al. 2017
Chayote (Choko)	Whole plant	Whole plant. Eaten	Eaten as vegetables	Antiinflamatory,	Phloretin, cucurbitacins, p-	Antioxidant; lipogenes	Generally safe	No information found	Aguiñiga-Sánch

[Sechium edule] (Cucurbitaceae)		as vegetable		antihypertensive, anti-diabetic,	coumaric acids, apigenin, phloridzin, caffeic, vanillic, naringenin, tyrosine, saponins, phenolic alkaloids, flavonoids,	is inhibition			ez et al. 2017; Rosado-Pérez et al. 2019
Cinnamon [Cinnamomum verum] (Lauraceae)	Stem, powder	Bark, powder, leaves.	Mixed with food, juices, or drank as tea. 1-2 cups 3 times	anti-inflammatory, antiviral, blood purifier, reduce cholesterol, antifungal, antibacterial, r	cinnamaldehyde , alkaloids, propenoids, saponins, flavonoids,	antioxidant, Anticholinesterase, PAF receptor binding	Generally safe	None reported	Kumar et al. 2019

			daily. Orally	educe blood glucose,	butanolides, terpinenes, steroids, actinodaphnine, coumarins, anthraquinones, kaempferol glycosides, eugenol,	antagonism			
Dandelion [Taraxacum officinale] (Asteraceae)	Leaves and stem	Teas	Drank as tea. Once or twice daily. Orally	Anti-diabetic, hepatic disease, CVS diseases, anti-cancer, osteoporosis,	Methylsterols, sesquiterpene lactones, cycloarte	fructo-oligosaccharides (FOS) helps normalize	No significant observable	None reported	Wirngo et al. 2016

					nol esters, sitosterol, minerals, carbohydrates, carotenoids, taraxerol,	BG; suppress oxidative stress; inhibits renal glucose reabsorption, inhibits potassioum channels,	toxicity;		
Eggplants [Solanum Molongena] (Solanaceae)	Fruits	Salads.	Eaten with food as salads	Hypolipidemic, antihypertensive, antimicrobial, analgesic, antiasthmatic, antioxidant, antipyretic,	chlorogenic acid, nasunin anthocyan, flavonoids, lamostero	Free radicals scavenging; inhibits lipid peroxidation	None reported	Chelates iron	Butu & Rodino 2019; Solanke & Tawar 2019

				antiplatelet, antidiabetic	l, glycoalkaloids, aspartic acid, tropane, gramisterol, arginine				
Flaxseed (linseed) [Linum usitatissimum] (Linaceae)	Seeds	Whole seed	Eaten as: partially or fully defatted, whole seed, oil	Anticancer, hypolipidemic, antihypertensive, analgesic, antimicrobial, antidiabetic, antiprotozoal,	alkaloids, linolenic acid, polysaccharides, cadmium, linoleic acid, cyclic peptides, lignans, cyanogenic	Antioxidant; immunomodulatory	Risk of toxicity with linatine, cyanogenic glycosides & cadmium may	Might decrease Vitamin B in Vitamin B-compromised persons	Shim et al. 2014; Ansari et al. 2019

					glycosides, minerals, selenium, vitamins		occur if flaxseed if taken in higher amount		
Garlic [Allium sativum] (Amaryllidaceae)	Bulb	Powdered, fresh bulb swallowed	Taken as spices with food, Swallowed whole,	Anti-inflammatory, hypocholesteremic, anti-cancer, antibacterial, hypotensive, prevention of arteriosclerosis.	diallyl disulfides (DADS), methyl thiosulfonate, Sallylcysteine (SAC), diallyl trisulfides (DATS)	Inhibition of vascular smooth muscle cells proliferation, reduction in angiotensin II-induced	Halitosis, unpleasant Taste, allergic reactions	Reduce the efficacy of saquinavir, Enhance the pharmacological effect of warfarin, fluindione	Chan et al. 2020; Kahraman et al. 2020

					and Allicin	vasoconstrictor responses, abrogation of the activation of NF-κB and inhibition of endothelin-1 induced vasoconstriction, hypolipidemic		, Atorvastatin, cilostazol	
Ginger [Zingiber officinale]	Fresh or dried root	Infusion, powder.	Taken as tea or mixed with	Analgesic, antipyretic, nausea, vomiting,	(6)-gingerol and (6)-shogoal	angiotensin II type 1 receptor	Considered gener	Interacts with insulin and	Khan et al. 2019;

(*Zingiberacea e)*			food. 1-3 cups 3 times daily. Orally	motion sickness,		blockade, ACE inhibition, lipid peroxidati on, Potent scavengi ng of oxidant, reduce levels of LDL, total cholester ol, vLDL and triglycerid es.	ally safe. Heart burn, diarrh ea, mouth irritati on	glibencla mide to lower blood glucose. Nifedipin e, phenproc oumon	Kahra man et al. 2020
Grapefruit [Citrus × paradisi] (Rutaceae)	Fruit, peel	Juice.	Taken as juice. 1-2 times	antiatheroscler otic, antihypertensiv e, anti-obesity	Naringeni n, naringin, phenols,	Inhibition lipidation; antioxida nt, ROS	None report ed	Felodipin e, Talinolol, Simvasta	Razavi & Hossei nzadeh

			daily. Orally	hypolipidemic, antidiabetic,	betacarotene, bergaptol, ascorbic acid,	& RNS scavenger.		tin, Aliskiren, Lovastatin, Atorvastatin	2019; Sadowski 2019
Guava tree [Psidium guajava] (Myrtaceae)	Leaves	Infusion, decoction.	Taken as tea. 1-3 cups 3 times daily. Orally	Skin infections; malaria; fever; respiratory infections, antidiabetic; anticancer; hypertension; CVS disorders; kidney and liver disease; antiparasitic,	Quercetin,	Reduction oxidative stress; decrease blood cholesterol and sugars	Generally safe for use	None reported	Daswani et al. 2017
Jackass bitters [Neurolaena lobata] (Asteraceae)	Leaves	Infusion, decoction.	1 cup twice daily. 1-3 cups 3 times	Antiparasitic, antifungal, antimalarial, anticancer, antidiabetic,	Sesquiterpene, tannins, flavonoids,	Inhibits cell proliferation, induces	Generally safe	None found	Walshe-Rousseel et al. 2013;

			daily. Orally	anti-inflammatory, diarrhea, antipyretic, antiulcer, antiarthritic, headaches,	alkaloids, saponins,	tumour suppression, triggers apoptosis of malignant cells			Nayak et al. 2014
Lemongrass [*Cymbopogon* andropogoneae/citratus (Poaceae)	Leaves	Infusion.	Taken as tea. 1-3 cups 3 times daily. Orally	Fever, GIT disorders, antimalarial, analgesic, anntibacterial, antipyretic	Citral, terpenes,	improvement of biochemical indices such as kidneys, vascular endothelium, diuretics	Safe for human consumption	None reported	Boukhatem et al. 2014; Ekpenyong, 2018
Lettuce [Lactuca sativa]	Fresh leaves	Eaten as	Eaten as vegetable	Anti-inflammatory; GI tract	phenols and flavonoid	Antioxidant, protects	None reported	None reported	Mampholo et al.

(Asteraceae)		vegetable.		disorders, enhances appetite,	s, lutein, vitamins, niacin, β-carotene, thiamine, riboflavin,	against oxidative stress; anxiolytic effects			2016; Harsha & Anilakumar 2013
Lime tree [Citrus aurantiifolia] (Rutaceae)	Leaves & fruits	Infusion, juice.	Taken as tea and juice. 1-3 cups 3 times daily. Orally	anti-lipidemic, antifungal, antibacterial, anti-inflammatory, anticancer, anti-hypertensive, cardioprotective, antidiabetic,	apigenin, essential oils, carotenoids, limonoids, flavonoids, quercetin, carotenoids, hesperetin, alkaloids, nobiletin,	Inhibition of metastasis; stopping cancer cell mobility in circulatory; inducing tumor suppressor gene and	None reported	None reported	Narang & Jiraungkoorskul 2016

					triterpenoids, coumarins, naringenin, kaempferol, rutin,	apoptosis; blocking the angiogenesis; antioxidant			
Mango tree [Mangifera indica] (Anacardiaceae)	Leaves	Infusion.	Taken as tea. 1-3 cups 3 times daily. Orally	Parasitic infections, uterine disorders, antihypertension, GI tract problems, anthelmintic, anti-inflammatory, anti-oxidant, antidiabetic,	Mangiferin, triterpenoids, flavonoids, polyphenolics,	Vasodilation, diuresis, ROS scavenger,	None reported	None reported	Mans et al. 2017; Shah et al. 2010

Marijuana [Cannabis sativa] (Cannabaceae)	Leaves & flowers	Smoke; infusions.	Smoked and taken as tea. 1-3 cups 3 times daily. Orally	Antidiabetic; anticancer; Analgeisc; parkinsons disease; nausea; vomiting; glaucoma; arthritis,	Δ-9-tetrahydrocannabinol (D9-THC); triterpenoids; sterols; flavonoids;	Canabinoid receptors Types 1 & 2	Suicidal ideation & behavior; might affect fertility; increased appetite; paranoia, dizinnes, hallucinations, cogniti	Sedatives; alcohol; antihistamines; antiseizure drugs, antidepressants, muscle relaxants	Bonini et al. 2018; Rajput & Kumar 2018; Jin et al. 2020; Gonçalves et al. 2019

							on deficit, euphoria; anxiety		
Moringa tree [Moringa oleifera] (Moringaceae)	Leaves, pods, powder,	Infusion, vegetable salad	Taken as tea. 1-3 cups 3 times daily. Orally	anticancer, lipid lowering, antioxidant, antidiabetic, anti-inflammatory, diuretic, antihypertensive,	vitamins, carotene, minerals, phytosterols, flavonoids, tannins, alkaloids, saponins, terpenoids, sterols, isothiocyanates, calcium, glycoside	Increase the estrogen production, scavenge the ROS	Generally safe, overdose causes hemochromatosis.	None reported	Gopalakrishnan et al. 2016; Moodley et al. 2018; Rani et al. 2018

					s, glucosinolates, iron, potassium, vitamins, copper, folic acid, calcium				
Neem tree [Azadirachta indica] (Meliaceae)	Leaves	Infusion.	1 cup 2-3 times a day. Orally	Hypertension, malaria, microbial infection, diabetes mellitus, anticancer, antival, anti-inflammatory, antifungal,	Nimbinin azadirachtin, salannin, nimbidol, nimbolinin, nimbin, gedunin, nimbidin, ascorbic acid, nimbiol,	cardiac depressant activity; vasodilation mediated through a combination of Ca2+ channel	General discomfort, bitter taste, nausea, diarrhea, may decre	Decrease the bioavailability of glipizide,	Tembe-Fokunang et al. 2019; Alzohairy, 2016;

					quertin, nimbanene, polyphenolic flavonoids, β-sitosterol	blockade, NO-inhibitory mechanisms, antioxidant activity due to scavenging free radicals	ase sperm quality		
Noni [Morinda citrifolia] (Rubiaceae)	Fruit	Juice	1-2 cups daily. Orally	Antihypertensive, antiviral, anthelminthic, antifungal, anti-inflammatory, anticancer, immune boaster; antidiabetic,	Flavonoids, methyl hexanoa, octanoic acid, ls, terpens, aldehydes, decanoic acid, coumarin,	Free radicals scavenging; decrease edema; inhibit Cox 1 & 2; Inhibits PGE2; inhibits	Generally safe	None reported	Ali et al. 2016; Almeida et al. 2019

				CVS diseases, anti-arthritic	phenolic acid, flavonoids;	NO; anthraquinones, sterols;			
Papaya tree [Carica papaya] (Caricaceae)	Leaves	Infusion	Taken as tea. 1-2 cups daily. Orally	Hypertension, antimalaria, diabetes, hypercholesterolemia, asthma, antifungal, anticancer,	Polyphenol, carotenoids, benzyl isothiocyanates, prunasin, benzyl glucosinolates	Diuresis, vasodilation	Generally safe	None found	Pandey et al. 2016; Priyadarshi & Ram 2018
Periwinkle [(Ram goat)	Leaves	Infusion	1 -2 cups	Antidiabetic, respiratory tract infections,	Flavonoids, alkaloids,	Antioxidants, free radical	Generally safe	No information found	Shoba 2017

[Catharanthus roseus] (Apocynaceae)			daily. Orally	diuretic; anticancer, antimicrobial, antifungal, antilipidemic, antiviral, wound healing, antihypertensive, anti-allergic, cardioprotective	terpenoids, saponin, vincristine, vinblastine,	scavenging; antithrombotic; vasodilation			
Pine tree [Pinus] (Pinaceae)	Bark	Decoction	PRN. Orally	Diaphoretic, antiseptic, rubefacient, hemorrhages, expectorant, antihelminthic, antimicrobial, measles, anti-inflammatory, anti-seizures, antidiabetic,	Flavonoids, terpenoids, xanthones, tannins, essential oils, rhamnetin,	Free radical scavenging	None reported	None reported	Sharma et al. 2018

					quercetin, sterols, kaempferol, taxifolin,				
Pineapple [Ananas comosus] (Bromeliaceae)	Skin	Decoction	Taken as tea dose. 1-3 cups 3 times daily. Orally	Improves angina pectoris, reversing inhibition of platelet aggregation,	Bromelain, vitamins, manganese, copper	thought to breakdown cholesterol thereby improving arterial and general cardiovascular function; may have effect on the serotoner	None reported	None reported	Pavan et al. 2012

						gic pathway			
Sage [Salvia officinalis] (Lamiaceae)	Leaves	Infusion	Taken as tea. 1-3 cups 3 times daily. Orally	Diuretic, anti-inflammatory analgesic, sedative, GIT disorders, antimicrobial, alzheimers, anticancer, antidepressant, anti-stress, antiviral, antifungal, anxiolytic,	borneol, carnosol, flavonoid, cineole, flavones, coumaric acid, phenolic compound,	Free radical scavenging	None reported	None found	Miraj & Kiani 2016; Hamid pour et al. 2014; Miraj et al. 2016
Scoggineal [Opuntia cochenillifera] (Cactaceae)	Fruit	Fruit eaten fresh or juiced	Fruit eaten fresh or juiced	Anti-diabetes, anticancer, decrease obesity, hypolipidemic, anti-therogenic,	phenolic acids, carotenoids, flavonoids, betalains,	Prevent formation of free radicals,	None reported	Increased risk of hypoglycemia when taken with	Del Socorro Santos Diaz et al. 2017

				anti-hypertensive, mental health, respiratory disorders	ascorbate, vitamins,			metformin, glipizide,	
Serosi (Cerasee) [Momordica charantia] (Cucurbitaceae)	Leaves	Infusion, decoction	1 cup up to 3 times daily. Orally	Antidiabetic, antiparasitic,	Terpenoid,saponins, heteropolysaccharides, phenols, flavonoids, peptides, proteins, fatty acids, sterols, essential oils and	antioxidant and anti-inflammatory properties	allergy to cucurbitaceae family and in individuals with glucose-6-phosphate dehydrogenase	Synergitic activity with rosiglitazone; causes hypoglycemia when used with metformin	Dandawate et al. 2016; Beniwal et al., 2017

					amino acids		deficiency because of risk of developing favism; reduced fertility; risk of kidney toxicity possible acute nephritis		

Sorrel [Hibiscus sabdariffa] (Malvaceae)	Calyx	Infusion	Taken as tea. 1-3 cups 3 times daily. Orally	antihypertensive, hepatoprotective, antimicrobial, antidiabetic, anticancer, hypocholesterolemic,	Polyphenolics, flavonoids, vitamins, Chlorogenic acids, kaempferol, Quercetin, anthocyanins, tartaric acids,	Vasodilation; stimulated diuresis; decreased blood lipid levels, diuretic, inhibiting ACE activity, decrease oxidative stress,	None reported	None reported	Islam 2019; Jalalyazdi et al., 2019;
Soursop [Annona muricata] (Annonaceae)	Leaves, fruit	Infusion, decoctions, juice	1-2 cups daily. 1-3 cups 3 times daily. Orally	diabetes mellitus; insomnia; nervousness, anxiety, hypertension,	Essential oils, alkaloids, flavonol triglycosides,	Vasodilation via Ca^{2+} channels blockade & via	Inhibition of mitochondrial compl	None reported	Mans et al. 2017a; Alatas et al. 2017;

				depression; hangover; epilepsy; parasitic & helminth infections; cancer;	phenolics ,	vagus nerve, decrease serum uric acid,	ex I of annon amine and annon acin		Yang et al. 2015
Susumba [Solanum Turvum] (wild tomato) (Solanaceae)	Leaves	Infusion s	Not specified	Hypertension, urinary tract infections, diarrhea, anti-inflammatory, anti-diabetic, anticancer, antmicrobial, hepatoprotecti ve	Steroidal alkaloids, spirostan e, sterols, glycoalkal oids, saponins, steroid glycoside s,	antioxida nt	No inform ation found	No informati on found	Musar ella 2019; Gao et al. 2019
Stinking toe [Hymenaea courbaril] (Fabaceae)	Fruit, bark, seed, leaves	Juice, infusion s, decocti ons,	Taken as juice or tea. 1-3 cups 3 times	Hypertension, anti-inflammatory, myorelaxant, dengue fever,	Coumarin s, flavonoid s, phenolic	vasodilati on	No inform ation found	No informati on found	Schwa rtz 2018

			daily. Orally	diarrhea, asthma, antimicrobial	acids, steroids, terpenoids, phthalides				
Tamarind [Tamarindus Indica] (Fabaceae)	Leaves, fruits	Infusions, juice	Taken as tea or juice. 1-3 cups 3 times daily. Orally	hypertension , parasitic infestations, abdominal discomfort, aphrodisiac, cardioprotective, anti-hyperlipidemic	Mucilage, terpenes, pectin, sugars, tannin, anthranilate, pectin, limonene, calcium, zinc, iron	Direct sympathetic inhibition; decreased blood lipid levels, antioxidant, protect against oxidative assault	None reported	None reported	Naeem et al. 2017

Trumpet tree [Cecropia peltata] (Cecropiacea e)	Leaves	Infusion s decocti on	Taken as tea. 1-3 cups 3 times daily. Orally	Hypertension, type 2 diabetes mellitus, respiratory diseases, inflammation, hypertension, malaria,	triterpern oids, phenolic acids, chlorogen ic acids, flavone C- glycoside	Antioxida nt	None report ed	None reported	Rivera- Mondr agon et al. 2017; Ortma nn et al. 2016
Tumeric [Curcuma longa] (Zingiberacea e)	Roots (rhizo me)	Infusion s, powder	Infusion s are taken as tea while powder is used with food as spice	Menstrual pain, peptic ulcers, pain, inflammation, digestive disorders, lipid lowering, hypertension	Curcumin oids, polysacc harides, volatile oils, and turmeron e, arturmero ne, zingibere ne	Free radical scavengi ng, hypochol esteramia , immune boaster,	Gener ally safe	May cause hypoglyc emia when taken with insulin, increase the risk of bleeding with NSAIDs.	Kumar et al. 2017; Qin et al. 2017; Kahra man et al. 2020; Ahmad et al. 2020

								Losartan, rosuvastatin, warfarin, clopidogrel and Talinolol	

*Reported doses and routes are from the participants, while the other information like active ingredients, presumed mechanisms of action, interactions with western medication, and toxicity is from the literature used to develop the guidelines.

5.7 RESEARCH OBJECTIVES, QUESTIONS, AND HYPOTHESIS

A numerical statement of a specific relationship about unknown parameters to the researcher is termed hypothesis (Rodrigues, Lima, and Barbosa et al. 2017:619). The hypothesis needs to be tested after collecting data that could be used to accept or reject the hypothesis. In this research, the hypothesis is tested from the percentages generated during the quantitative phase and used to draw inferences with the qualitative data (Creamer, 2018:145).

5.7.1 Research objectives

The objectives of this study, as described in chapter one, were as follows:

5.7.1.1 Phase 1: Quantitative phase

- To determine the indigenous therapies used by hypertensive patients in Belize to treat hypertensive conditions.
- To identify the common western therapies used in the treatment of hypertension in Belize.
- To identify concomitant usage of indigenous-western therapies among hypertensive patients in Belize.

In order to achieve the above set objectives, data were collected quantitatively utilizing a questionnaire. A total of 422 participants were surveyed using a well-structured and verified questionnaire. Information collected from participants was grouped into demographic, western medication, and indigenous therapy usage. Collected were was analyzed using SPSS version 21.0 software. Results are presented in frequency tables, graphs, and charts. The most common Western antihypertensive medicines reported by the respondents were hydrochlorothiazide and captopril. The majority (n=335; 33.7%) of the respondents reported being on hydrochlorothiazide, while 12.3% (n=122) were on captopril. Respondents reported over 30 different medicinal plants used for indigenous therapies in the management of hypertension in Belize. Beetroot (n=56; 13.3%), garlic (n=45; 10.7%), and aloe vera (n=27; 6.4%) were among the highest reported indigenous therapies used for the management of hypertension. The majority (48.3%) of the respondents indicated they do not take indigenous therapies to manage hypertension. Approximately 29.4% combine indigenous-western therapies in the management of their hypertension.

5.7.1.2 Phase 2 Qualitative phase

- To explore and describe the preparation, storage, and usage of indigenous therapies by hypertensive patients in Belize.
- To understand the concomitant use of indigenous-western therapies by hypertensive patients in Belize.

The above objectives were achieved using qualitative analysis. Two sets of data were collected on indigenous-western therapies for treating hypertension. The first set of data was collected from patients diagnosed with hypertension who used either or both indigenous and western therapies to manage hypertension, while the second set of data was collected from vendors of indigenous therapies. Face-to-face interviews were used for data collection from both hypertensive patients and the vendors of indigenous therapies. Data were analyzed using thematic analyses and results presented. Data collected qualitatively from hypertensive patients and vendors of hypertensive therapies provided a more in-depth understanding of the use of indigenous therapies among Belize’s population and helped achieve set objectives for the research. Plants were the most common indigenous therapies reported by both hypertensive patients and the vendors of indigenous therapies. The participants also reported leaves as the most used part of the plants, while boiling was the most used preparation method. The most-reported administration route was oral, while ½ to 1 glass of the plant extracts are usually administered twice or trice per day. Most participants reported taking either indigenous therapies or Western medications alone.

A few participants combined the therapies, while most respondents reported not experiencing side effects with indigenous therapies. Indigenous therapy vendors reported that their therapies are effective in controlling blood pressure. Some of their claims were verified by Western science, as noted in Table 5.2.

5.7.1.3 Phase 3 Guideline development

- To develop guidelines on the use of indigenous-western therapies for the management of hypertension in Belize.

Data generated from both quantitative and qualitative phases were mixed to provide detailed guidelines on the use of indigenous-western therapies as reported by both hypertensive patients and vendors of indigenous therapies. The data collection procedure followed an explanatory sequential mixed method design. The principle of triangulation was used to combine the quantitative and qualitative data that aided in developing the guidelines. The guidelines included parts of the plants used for hypertensive management, how to process the indigenous therapy, the recommended dosage, how the remedy should be taken, and reported adverse effects or interactions when used with western medicines.

5.7.2 Research questions

The research questions for this study were as follows.

5.7.2.1 Phase I

- What are the common indigenous therapies used by patients to treat hypertension in Belize?
- What are the common western therapies used by hypertensive patients in Belize?
- Do Belizean hypertensive patients combine indigenous-western therapies in the management of their hypertension?

As reported by the research participants, the common indigenous therapies used in managing hypertension were from plant sources. The most common Western antihypertensive medicines reported by the respondents were hydrochlorothiazide and captopril. The majority (n=335; 33.7%) of the respondents reported being on hydrochlorothiazide, while 12.3% (n=122) were on captopril. Respondents reported over 30 different medicinal plants used for indigenous therapies in the management of hypertension in Belize. Beetroot (n=56; 13.3%), garlic (n=45; 10.7%), and aloe vera (n=27; 6.4%) were among the highest reported indigenous therapies used for the management of hypertension. The majority (48.3%) of the respondents indicated they do not take indigenous therapies to manage hypertension. Approximately 29.4% combine indigenous-western therapies in the management of their hypertension.

5.7.2.2 Phase II

- How are indigenous therapies prepared, stored, and used by hypertensive patients in Belize?
- Why do hypertensive patients in Belize use indigenous therapies?

Although no standardized method was reported by participants, boiling of medicinal plant parts was the commonly reported method of preparation reported by hypertensive participants. Furthermore, most participants in this study reported the oral route as the primary route for medicinal plant administration. Participants take medicinal preparations as decoctions, teas, juices, mixtures of boiled plant parts, or herbs to manage their hypertension. In addition, respondents reported taking between half a glass to full glass of medicinal plant therapies are taken either once or twice per day, as reported by most participants. Some participants reported taking medicinal plant therapy anytime and for the entire day.

5.7.2.3 Phase III

- What guidelines should hypertensive patients in Belize use in the management of their hypertension using indigenous-western therapies?

Detailed guidelines on using indigenous-western therapies were presented in Table 5.2 based on the outcomes obtained from the studies' qualitative and quantitative phases. The guidelines included parts of the plants used for hypertensive management, how to process the indigenous therapy, the recommended dosage, how the remedy should be taken, and reported adverse effects or interactions when used with Western medicines. In addition, few mechanisms of action for recommended medicinal plants were proposed by the vendors. These mechanisms of action included antioxidant activity, antidiuretic, hypolipidemic, and immunomodulation activity. Generally, mechanisms of actions attributed to many medicinal plants used in managing hypertension have been reported and discussed in chapter four.

5.7.3 Research hypothesis

The hypothesis statements made from the beginning of the study were:

- H_0. The use of indigenous-western antihypertensive therapies does not control high blood pressure than a single therapy approach among the Belizean population.

Based on the results in chapter four of the quantitative phase, the above hypothesis is accepted ($P<0.0001$). This means that individuals diagnosed with hypertension either use indigenous therapies or western medicines to manage their hypertension. According to both quantitative and qualitative results obtained in this study, most of the respondents during the qualitative study did not combine indigenous and western therapies to manage their high blood pressure. In addition, most hypertensive patients who participated in the qualitative study indicated taking indigenous therapy as the sole method for managing hypertension, or they used Western medications but not a combination of both.

The alternate hypothesis, as described in chapter one, is stated below:

- H_1.The use of indigenous-western antihypertensive therapies controls high blood pressure than single therapy among the Belizean population.

The above hypothesis is rejected based on the findings in chapter four of the quantitative phase. Therefore, to have good control of high blood pressure, both respondents in phase I of the study and the participants in phase II use or recommended either therapies but not a combination of both. In addition, few of the respondents in this study reported combining indigenous therapies used for the management of hypertension with prescribed western antihypertensive medications. About 29.4% (n=124) of the respondents reported combining indigenous therapies with prescribed Western antihypertensive medications to manage their hypertension. The major reason for combining indigenous therapies with Western medications was that the combination is more effective (28.3%; n=119) and helps lower blood pressure faster (38.8%; n=164).

Respondents (29.4%) who indicated combining indigenous-western therapies is low compared to those who do not use indigenous therapies (47.9%). Also, the respondents (28.3%) indicated that the indigenous-western combination to be effective compared to those who do not take indigenous therapies (48.3%) is also low. Therefore, the z-score test for two population proportions was used to test the level of significance for two populations (McLeod 2019:1). The level of significance was set at $p < 0.05$. The value of z was -5.5143, while the value of p was < .00001. The result is, therefore, significant at p < .05. Based on the statistically significant p<value (0.0001), it is indicative that a combination of indigenous-western antihypertensive therapy does not control blood pressure than a single therapy approach.

The participants for both the users of indigenous therapies and the vendors of indigenous therapies in the qualitative phase of the study laid credence to the efficacy of indigenous therapies in managing hypertension. With the qualitative study, both users and vendors reported a low level of concomitant use of indigenous and western therapies for hypertensive management. The singular use of indigenous therapy was reported to be efficacious by both users and vendors alike. In addition, some of the medicinal plants identified were also confirmed by science to have bioactive compounds that can lower blood pressure.

5.7.4 Research design and method

The mixed-methods methodology research with the multiphase design described by Creswell (2015:67) was followed to provide baseline level data in the use of indigenous-western antihypertensive therapies in Belize. Data generated from both quantitative and qualitative phases were mixed to provide detailed guidelines on the use of indigenous-western therapies as reported by both hypertensive patients and vendors of indigenous therapies. The data collection procedure followed an explanatory sequential mixed method design. The principle of triangulation was used to combine the quantitative and qualitative data that aided in developing the guidelines. Methods of triangulation in this study involved having quantitative and qualitative data elucidated complementary aspects of the study, where the diverged data provided greater insights than a single data collection method.

The different research methodologies employed using quantitative and qualitative approaches have helped provide greater authenticity and value in the quality of the data collected, analyzed, and reported in this study. First, priority on quantitative data (QUAN) collection and analysis were given. This was done by introducing it first in the study and representing a significant aspect of data collection. A small qualitative (qual) component typically followed in the second phase of the research. Second, quantitative data was first collected in the sequence, followed by the secondary qualitative data collection. This was presented in two phases, with each phase clearly identified in headings on the report. Third, the qualitative data was used to refine the results from the quantitative data. The refinement of the results led to exploring a few typical cases, probing a key result in more detail, and following up with an outline.

In addition, a robust literature was reviewed that provided rich and current information on indigenous and Western therapies used in hypertension management. The reviewed literature assisted in the design of the questionnaire that was used for quantitative data collection. The data collection questionnaire was well designed and questions pre-tested for their relevancy, preciseness, and clarity.

Part of the items included in the questionnaire was adopted and modified from previous studies. Experts in the field, including the research supervisor, provided useful input to ensure the research tool's validity. The researcher personally administered the questionnaire and offered useful guidance to respondents that needed help with language translation. The reliability of the research tool was assured by using statistical methods, as described in chapter three. Finally, the WHO Handbook for guidelines development was followed in ensuring standardization in the development of the guidelines (WHO 2014:6).

The findings obtained from this research adequately answered research questions while achieving set objectives. The robust data collected, analyzed, and presented has helped achieve all research objectives.

5.8 VALIDITY, RELIABILITY AND TRUSTWORTHINESS

5.8.1 Validity

Elo et al. (2014:1) described validity as the research instrument's ability to measure ideally what is supposed to be measure. The data collection questionnaire was well designed and questions pre-tested for their relevancy, preciseness, and clarity. Part of the items included in the questionnaire was adopted and modified from previous studies. Furthermore, reviewed literature, experts in the field, including the research supervisor, provided useful input to ensure the research tool's validity. The researcher personally administered the questionnaire and offered useful guidance to respondents that needed help with language translation.

5.8.2 Reliability

The primary role of reliability in research is to minimize biases and errors encountered in the study. In addition, reliability refers to the extent to which a given study is consistent and stable when the same techniques are applied in a repeated number of ways or the scores from an instrument are stable and consistent (Creswell 2015:159). The use of statistical methods assured the reliability of the research tool. Reliability testing of the questionnaire showed a Cronbach's alpha value of 0.779. The exploratory factor analysis (EFA) using principle component analysis extraction and direct oblimin rotation with Kaiser Normalization was also employed, which extracted five components. The Kaiser Mayer Olkin (KMO) measure of sampling adequacy and Bartlett's test for sphericity was also employed, which reported a value of 0.6 and a significant *p-value* less than 0.001, respectively.

5.8.3 Trustworthiness

In order to establish asperity in the qualitative phase of the study, triangulation, peer briefing, and member checks credibility strategies were adopted in this phase of the study. The confidence that can be placed in the truth of qualitative research findings is defined as its credibility (Anney 2014:276). Methods of triangulation in this study involved having quantitative and qualitative data elucidated complementary aspects of the study, where the diverged data provided greater insights than a single data collection method. A few colleagues at the University of Belize were subjected to peer briefing on some of the data to ensure the study's credibility. At different times the study's findings were crosschecked with participants to confirm the report's accuracy, making the data more credible. In addition, to ensure trustworthiness in the qualitative phase, a detailed description of inquiry was kept from the beginning to the end of the study. Finally, some of the research participants were given the opportunity to evaluate the research's findings, interpretation, and recommendations to ensure consistency and agreement. During the entire process, the researcher maintained neutrality through a reflexive journal and confirmability through triangulation.

5.9 SUMMARY

This chapter presents the convergence of findings from both phases I and II of this study. The converged data provided information for the formulation of guidelines on the use of indigenous-western anti-hypertensive therapies.

A total of 47 medicinal plants used in managing hypertension in Belize were reported by the research participants in qualitative and quantitative studies. The medicinal plants were organized and presented based on the family they belong to, their phytochemicals, presumed pharmacological action, toxicity, interactions with western medications, common methods of preparation, and administration routes. Identified medicinal plants in the study, information on preparation methods, routes of administration, and frequency of administration were obtained from study participants. The mechanisms of action, phytochemical properties, toxicities, and medicinal plants' interactions were obtained from the reviewed literature. Based on the guidelines above (Table 5.2), it can be suggested that both approaches of treating hypertension with indigenous and Western therapies can co-exist as long as the safety precautions are practiced. It can also be proposed that no approach should be given preference over the other based on what the participants in this study said about these approaches. It is important to note that indigenous and Western health practitioners in Belize acquire an understanding of how each system works. These findings will make it easy for patients to have freedom of choice for their health and help the community. These guidelines serve as the basis for more guidelines to be developed by other researchers to treat other conditions for which medicinal plants are used in Belize.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

Indigenous therapies have been with humans since ancient times and are still relevant, effective, and trusted by many indigenous communities (Mphuthi 2015:201). In addition, indigenous therapies have been the source of many Western therapies, and new medicines are still being discovered today from indigenous knowledge. Scientific evidence from clinical trials and accumulating literature from epidemiological research makes indigenous therapies slowly embedded into evidence-based Western medical practice (Al Disi et al. 2016). With all the progress being made with indigenous therapies, many Western medical practitioners, Belize included, have disconnected themselves from collaborating with indigenous therapy knowledge holders to provide a holistic healthcare approach to public health. However, the World Health Organization and many countries have taken a bold step to recognize and promote indigenous therapies and their use in managing many diseases (WHO 2019:8).

The previous chapter discusses the convergence of data findings from quantitative and qualitative (hypertensive patients and vendors of indigenous therapies) phases. The chapter also presented suggested guidelines for indigenous therapies to manage hypertension and concomitant use with Western therapies.

This chapter presents the gap between indigenous therapies and Western health practices, conclusions of the study, relationship statements between Belizean indigenous knowledge holders and Western therapy sciences recommendations, and insights gained from the research that contributed to indigenous knowledge systems in Belize and the Caribbean.

6.2 THE GAP BETWEEN INDIGENOUS THERAPIES AND WESTERN HEALTH PRACTICES

Carrie, Mackey, and Laird (2016:129) reported the United Nations Declarations' adoption on the Rights of Indigenous People (UNDRIP), where global recognition was accorded to more than 370 million people representing 5000 divergent groups globally in 2007. Previously, indigenous knowledge was not recognized, creating gaps between indigenous and Western healing systems with given rise to myths that continually discredited indigenous healing methods. Indigenous medicines, health practices, and social and health practices rights of the indigenous people were affirmed in the UNDRIP. Furthermore, the World Health Organization (WHO) took bold steps to close the knowledge gap between indigenous (traditional, alternative, and complementary) therapies with Western healing systems by producing the WHO global report on traditional and complementary medicine documents. The WHO report highlighted the need for collaboration between indigenous and Western healers to manage diseases while documenting the various indigenous and complementary medicines from different member nations (WHO 2019:4). In addition, the collaboration between indigenous and Western healers was aimed at complementing a good understanding of holistic patient care and research.

Despite these international efforts to encourage collaboration between indigenous and Western healers and the long ancestral history of indigenous therapies usage in Belize, indigenous therapy is not recognized by Western healers and grossly marginalized in Belize. This marginalization of the indigenous therapy approach has also been reported in most countries (Mphuthi 2015:218). Presently, there is no policy regarding indigenous therapies in Belize, even though the practice existed before pre-colonial times. Even today, Belizeans use indigenous therapies as mainstream therapy before consulting Western healers. Finally, Belize is yet to respond to the call to collaborate in recognizing indigenous therapy practice as part of a holistic approach to healthcare.

Therefore, based on the above, this study provides insights into indigenous knowledge systems in managing hypertension in Belize. In addition, the results of this study further revealed the need for Western healers to collaborate with indigenous therapies rather than marginalizing them. The collaboration will facilitate a holistic approach in healthcare and create a more in-depth understanding between trained Western practitioners and indigenous therapies. Mphuthi (2015:213) reported that indigenous healthcare systems and Western practices are usually a part of a broader knowledge regarding health, illness, and the relationship between nature and humans. A complex relational kinship exists between the people, animals, and the environment in a natural community. This complexity requires a holistic approach for harmony to be sustained in the community.

In contextualizing the statement above, the study participants indicated concomitant use of indigenous and Western therapies to which the trained Western healers were unaware. Additionally, participants alluded to not using their antihypertensive medications, even though they went to visit the doctors to refill the drugs and validate the effectiveness of the indigenous therapies they are using to manage their hypertension. It was evident that the lack of interest in indigenous therapies by trained Western healers has created a disconnection between them and the patients they treat and, by extension, the communities they serve.

6.3 RELATIONSHIP STATEMENTS BETWEEN BELIZEAN INDIGENOUS SCIENCES AND WESTERN SCIENCES

Mphuthi (2015:213) reported a relationship between the widely known scientific knowledge and indigenous knowledge since they both generate knowledge. These relationships have been reported by a few authors (Mphuthi 2015:213; Marsh, Coholic, Cote-Meek, and Najavits 2015:14; Carrie et al. 2016:129). Some of the highlights statements are listed below.

- Western science has enjoyed and is still enjoying the global status while indigenous science enjoys the local status.
- Both indigenous and Western scientific knowledge have identical foundations and are built on the same philosophies. Since Western science was given full and unreserved acceptance, indigenous science should be accorded the exact status of unreserved acceptance.

- The direct comparable nature of Western and indigenous science can benefit the community appropriately and provide a holistic approach appropriate for the intended use.
- Much Western science is narrowly defined in terms of testing, adopting, or rejecting external advice. Indigenous science may validate Western science, while in the same vein, Western science may support and corroborate indigenous knowledge, especially in ethno-scientific research (Mphuthi 2015:216). This study showed that several Western scientific claims were validated by indigenous science and not necessarily through a discovery.
- Both indigenous and Western sciences need to be open to learning from each other because both have unique ideas that can benefit the community. In this study, results showed that some claims made by indigenous people on the efficacy of medicinal plants to lower blood pressure could not be scientifically validated. To continue with such claims and practices could be detrimental to the community and public health.
- In a few scenarios, these authors allude that sometimes Western science gets it wrong, the indigenous science most often gets it right. The community needs to respect both sciences.
- In order to gain a wider acceptance for both indigenous and Western sciences, there has to be a point of agreement and compromise on the part of both sciences. For instance, this study showed that indigenous therapists administered most medicinal plants orally long before the advent of Western science. Also, the parts of the plants used by Western science as a source of medicines were the same plant parts used by indigenous science. It clearly shows that agreement between the two sciences exists as previously reported in the hybrid approach (Mphuthi 2015:218).

- The outcome of this research showed that indigenous people have good experiences in medicinal plants for the management of their hypertension. Also, the vendors had success stories in the management of hypertension and other diseases using indigenous therapies. Reviewed literature verified and confirmed some of these therapies, making both Western sciences have similar approaches and outcomes in managing hypertension. Results of this study, therefore, provide Western scientific support to indigenous therapy practices in Belize.

6.4 CONCLUSIONS FROM THE LITERATURE AND STUDY FINDINGS

A total of 47 medicinal plants allegedly used in the management of hypertension in Belize were mentioned by all the participants in both qualitative and quantitative studies. The medicinal plants were organized and presented based on their family, phytochemicals, presumed pharmacological action, toxicity, interactions with Western medications, common preparation methods, and administration routes. The medicinal plants in this study, information on preparation methods, routes of administration, and frequency of administration were obtained from study participants, while the mechanisms of action, phytochemical properties, toxicities, and interactions of medicinal plants were obtained from reviewed literature. The medicinal plants reported in this study belonged to 34 families made up of Amaryllidaceae, Anacardiaceae, Annonaceae, Apiaceae (2), Apocynaceae, Asphodelaceae, Asteraceae (3), Bixaceae, Bromeliaceae, Cactaceae, Cannabaceae, Caricaceae, Cecropiaceae, Chenopodiaceae, Cucurbitaceae (3), Euphorbiaceae, Fabaceae (2), Lamiaceae, Lauraceae (3), Leguminosae, Linaceae, Malvaceae (2), Meliaceae, Monimiaceae, Moraceae, Moringaceae, Myrtaceae, Pinaceae, Poaceae, Rosaceae, Rubiaceae (2), Rutaceae (2), Solanaceae (2), and Zingiberaceae (2), as shown in Table 5.1 above. The medicinal plants with the highest mention belonged to the Asteraceae (3), Cucurbitaceae (3), and Lauraceae (3) families. The phytochemicals found in most plants produced their mechanism of action through antioxidant activity (Shaik et al. 2020:1008).

The generation of reactive nitrogen species (RNS) and reactive oxygen species (ROS) by the human body due to normal biochemical activities, dietary chemicals, and the environment leads to oxidative stress and pathological conditions. Antioxidants found in medicinal plants have been reported to be effective because of their ability to donate hydrogen atoms (Nimse and Pal 2015:27986). The antioxidant activities of medicinal plants are mainly due to flavonoids (kaempferol, quercetin, naringenin, and catechin), phenolic acids (rosmarinic acids, gallic, caffeic, and protocatechuic), volatile oils (menthol, eugenol, thymol, and carvacrol), and phenolic diterpenes such as rosmadial, carnosol, rosmanol and carnosic acid (Nimse and Pal 2015:27986). Additionally, resveratrol, catechins, proanthocyanidins, phenolic acids, and epicatechins antioxidant activity can be seen in extracts of grape skins, seeds, and teas. Anthocyanidin and anthocyanin have also been reported to donate hydrogen atoms to oxygen radicals and chelate metals in slowing the oxidation reactions (Nimse and Pal 2015:27986).

Information regarding the possibilities of interactions between medicinal plants and Western medications is also presented in chapter five (Table 5.2). There is a public perception that most medicinal plants are safe because they come directly from the earth with no change, scientifically proven to be true (Mphuthi 2015:213). A paucity of information was seen regarding toxicities and interactions with Western medications for some medicinal plants presented. Most of the information identified on toxicities and interactions in research was based on cellular assays, hypothetical, inferred from other indirect means, or based on inference from animal studies (Asher, Corbett, and Hawke 2017:1). Mphuthi (2015:213) conducted a mini-trial with rats testing the two commonly used medicinal plants' toxicity. This study showed no kidney or liver toxicity, and the study utilized crude plant extracts to test toxicity. The limitation was that the sample was small, but this study gave the baseline information about indigenous therapy use.

Meaningful, well-designed clinical studies evaluating medicinal plant toxicities and interactions are mostly inconclusive and very limited (Shaik et al. 2020:1008). In the use of indigenous therapies with Western medications such as digoxin, chemotherapeutic agents, and warfarin, care must be taken to such drugs because of their narrow therapeutic index (Asher et al., 2017:1). The potential for herb-drug interactions has been extensively reviewed and presented in some studies (Shaikh et al. 2020:1008; Kahraman et al. 2020). For instance, the oral bioavailability of various drugs, including calcium channel blockers, have been reported with grapefruit juice. In addition, the oral bioavailability of drugs like simvastatin, midazolam, and terfenadine was also seen in grapefruit juice (Kahraman et al., 2020; Shaikh et al. 2020:1008; Herb-Drug Interactions 2015:1).

6.5 RECOMMENDATIONS

Based on this research's outcomes, the following paragraphs discuss recommendations to policymakers, healthcare practitioners, indigenous therapy vendors, indigenous therapy users, and research and learning.

6.5.1 Recommendations to policymakers

The following recommendations to policymakers are aimed at encouraging policymakers to promulgate policies that will promote the use of indigenous therapies and collaboration between indigenous therapists and Western healers:

- Policies have to be made to incorporate indigenous therapies as part of a holistic approach to healthcare since, from the results of this study and reviewed literature, such incorporation provides corroboration between indigenous and Western sciences.
- There is a need for an awareness campaign by the Ministry of Health on the need for hypertensive patients to exercise caution with medicinal plants to manage hypertension. Since presently not many medicinal plants have gone through thorough scientific investigations, including pre and post clinical trials, the possibilities of harmful toxicities cannot be overlooked.
- Plants that have shown remarkable efficacies with proven pre and post clinical studies should be approved for supplemental usage by hypertensive patients in Belize. Presently, there is no clear policy from the Ministry of Health on medicinal plants and alternative medicines to manage diseases, especially metabolic

disorders in Belize. Developing such policies will help regulate the use of medicinal plants.

- As a country, presently, Belize is not a member of the WHO's efforts on indigenous, complementary, and alternative medicines. Membership accords a global partnership to member states to regularly share strategies for the safety, quality, and efficacy of indigenous and alternative therapies. Being a member will also help the country formulate policies on indigenous and alternative therapies based on WHO guidelines and research findings.
- Indigenous therapy vendors should be recognized, and their knowledge incorporated into holistic care discussions at all healthcare system levels, including the university curriculums.
- Policy regarding the harvesting and preservation of medicinal plants in the country be made to ensure the passing of information to the next generation.

6.5.2 Recommendations to healthcare practitioners

The following recommendations are aimed at encouraging healthcare practitioners to discuss the use of indigenous therapies with their patients in order to provide a holistic approach to hypertension management:

- Healthcare personnel should be encouraged to discuss the use of medicinal plants during consultations with hypertensive patients. The majority of the participants indicated that their doctors did not ask them about indigenous therapies. Discussing with the patients during consultations will guide the healthcare team to design appropriate interventions for the patients and minimize herb-drug interactions.
- Healthcare personnel should update their knowledge of recent information regarding indigenous therapies to help their patients.
- The nurses have to be well informed about medicinal plants' use to connect the doctors and patients.

6.5.3 Recommendations to vendors of indigenous therapies

The following recommendations to vendors to encourage the vendors to harmonize their therapies and develop a cross-referral system:

- There is an urgent need for indigenous therapists to harmonize their therapies in terms of dosage, duration, and medicinal plant intake frequency.
- Indigenous therapy vendors should make an effort to document detailed formulations of their therapies for standardization and pass on such knowledge to the generations behind them.
- Indigenous therapy vendors should update their knowledge of medicinal plants' abilities to heal and interactions with Western medications.
- Both indigenous vendors and Western-trained doctors need to discuss the approach used by each system; this will provide respect and have a cross-referral system.

6.5.4 Recommendations for users of indigenous therapies

The following recommendations to indigenous therapy users will encourage users to have current knowledge of both indigenous and Western therapies used for the management of hypertension:

- This study's findings strongly suggest that indigenous therapies have been used successfully in the management of hypertension. The confidence of the users, vendors, and available scientific data advocates indigenous therapies alongside Western therapies. Therefore this study recommends the practice to be identified and incorporated as part of a holistic approach to managing hypertension.
- There is a need to create patient awareness to maintain consistency in taking their prescribed Western medications to avoid resistant hypertension, rebound hypertension, interactions, and toxicities.
- Users of indigenous therapies should also be educated on the dangers of herb-drug interactions. A well-spaced time between the use of indigenous and Western therapies should be encouraged to avoid interactions.

- Indigenous therapy users should be encouraged to share with their doctor's information on medicinal plants they are using for any purpose.
- The users should present a near standardized prescription when asked about indigenous therapies for their condition.

6.5.5 Recommendations regarding teaching and learning

These recommendations are made regarding teaching and learning at the teaching institutions based on this study's findings on the medicinal plants and their uses.

- Necessary identification and compilation of all plant species native to Belize need to be conducted and regularly updated. The compilation should include medicinal use, phytochemistry, toxicology, and interactions. Presently, there is a paucity of updated information on the medicinal plants endogenous to Belize, especially those used in managing hypertension.
- Acute and chronic toxicological studies by the University of Belize and other research institutions in the country need to be urgently conducted to identify toxicities of medicinal plants unique to plant species endogenous to Belize, especially those used in the management of hypertension.
- Collaborative discussions and research should be conducted between indigenous therapy vendors and university faculty to identify and document bioactive compounds found in Belize's medicinal plants. The efficacy of medicinal plants in managing and treating many disease conditions should continually be investigated, documented, and made public.
- Conferences, workshops, seminars, and congresses should be jointly held between faculty, indigenous vendors, and health practitioners as a means of healthy interaction and sharing of knowledge.
- Collaborative research with national and international researchers needs to be adopted to research the effectiveness, biological effects, and pharmacological usefulness of medicinal plants. With the variety of medicinal plants in Belize, this collaboration could facilitate a medicinal plant research center at the University of Belize.

- A postgraduate diploma or certificate course should be designed at the university to help preserve indigenous knowledge and help indigenous therapy vendors with certification (Jacobs 2015:50).
- Curriculum for nurses and doctors should incorporate indigenous knowledge systems to have health practitioners who are well informed about both care systems.

6.5.6 Recommendations for the public

The following are the recommendations to the general public in Belize based on the findings of this study.

- Since indigenous therapy has been in existence before Western medicines and has effectively been used to treat various diseases with proven efficacy, indigenous therapy and Western therapies can co-exist to provide holistic healthcare to the Belizean population.
- Western therapy's approach is not a consultation approach in most cases, rather a system that tells the patient what to do. The approach needs to change to a consultative approach between the community and the Western medicine practitioners.
- The public needs to be adequately informed on indigenous therapies, especially related to such therapies being combined with Western therapies. Information on dosing, frequency of intake, and possible interactions should be verified before consuming indigenous therapies. Safety considerations should always be taken into account with any therapy.

6.5.7 Recommendations for research

The following recommendations are made for future research, and they are based on the findings of this study.

- More research on indigenous knowledge systems should be conducted by faculty to help unravel novel approaches to therapy and disease management and to document such knowledge.

- Research to standardize and harmonize indigenous therapies should help patients and vendors as they utilize indigenous therapies.
- The ethical and legal rights of indigenous vendors must be made known to the public and adequately respected. Their intellectual property rights and the right to voluntarily participate in research must be respected.
- A memorandum of understanding or contract must be entered between researchers and indigenous therapist.
- Researchers need to acknowledge that they will be taught by the public when undertaking this form of research. The reason is that indigenous knowledge is based and generated in the community.
- Researchers have to be aware that most of this knowledge is not documented and passed from generation to generation orally.
- It is also recommended that the researchers show respect to the community by not only taking their knowledge just for research purposes with no benefits.
- When undertaking the research, the community's morals and values have to supersede the research ethics as the community cannot be forced to do what they are not free to do.
- The community should not be forced to communicate things that they regard as sacred and secrets of their knowledge and practice.

6.6 CONTRIBUTORY STATEMENTS AND INSIGHTS DERIVED FROM THIS RESEARCH

The following contributory statements spawned from the research objectives and research questions:

- A respectful interaction between the researcher and the research participants (especially the vendors) was observed. For instance, some vendors did not reveal some of the detailed recipes used to prepare their therapies. The researcher respected the decisions of the vendors.
- The researcher did not approach the indigenous community with pride from Western knowledge; instead, with humility, the researcher showed respect to the

indigenous community and learned without interference. Being at an equal level with the indigenous community opens the door for mutual respect and learning.

- The hypertensive participants and the indigenous therapy vendors used various medicinal plants to manage hypertension, unknowingly validated as useful by trained Western healers. Due to prolonged use and proven experience, the indigenous community has also trusted their remedies as useful. The quantitative and qualitative baseline data collection methods used in this study and the reviewed literature on preclinical and clinical studies prove that these medicinal plants heal many diseases. To further undermine the community by anyone in the Western health care practice is a disservice to indigenous knowledge systems that have been proven to be safe and efficacious even by science.
- Despite concerns over medicinal plants' safety, the indigenous community reported medicinal therapies to be relatively safe in this study. In addition to safety, medicinal plants were also reported to be available as most of the plants are cultivated by the communities or found in the wild. The plants were also reported to be affordable to those who do not cultivate them.
- The indigenous community reported very minimal toxicities in the use of indigenous medicinal plants to manage hypertension, even though the community reported no standardization. Therefore, it is logical to assume that if the indigenous community is trained with knowledge in measurements and dosing, the few toxicities reported could be eliminated or made insignificant.
- Based on reviewed literature and the fact that many drugs were historically discovered from medicinal plants, it is imperative to acknowledge that indigenous people's medicinal plants can also be investigated in the Western laboratory to discover active ingredients useful for the cure of diseases.
- The reviewed literature and the results seen in this research showed that not many differences exist between indigenous knowledge systems and Western scientific outcomes. Indigenous communities have their science and methods that need to be respected by the Western healers.

6.7 FINAL REMARKS

The proposed execution of this study was discussed in chapters one and three. The final remarks took into consideration of the outlined execution plan of the research. A mixed-method exploratory research approach was utilized for data collection, as described by Creswell (2015:35). The final remarks for each phase are presented below.

6.7.1 Phase 1 (Quantitative)

Data was collected quantitatively from the hypertensive patients in Belize. The respondents identified valuable medicinal plants used in the management of hypertension in Belize. The respondents also identified common Western therapies for hypertension. Most respondents used either indigenous therapies or Western therapies for the management of their hypertension. A few of the respondents indicated combining both therapies for the management of their hypertension.

This phase saw the hypothesis accepted that the combination of indigenous-western therapies does not lower blood pressure than a single therapy based on the findings of this phase's results, summarized above.

6.7.2 Phase 2a (Qualitative – hypertensive patients)

Qualitative data was obtained through interviews with hypertensive patients. Hypertensive participants in the study identified plant sources for the management of hypertension. Leaves were the common plant part used by hypertensive patients, and the common process of preparation is boiling. The oral route was identified as the most common route of administering medicinal therapies by the hypertensive participants. Most respondents do not combine indigenous and Western therapies and generally reported that effective blood pressure management is seen with the combination. The participants reported fewer side effects, and most of them considered the indigenous therapies safer, natural, and readily available compared to Western therapies.

6.7.3 Phase 2b (Qualitative – vendors of indigenous therapies)

Vendors of indigenous therapies for the management of hypertension contributed immensely to the study by providing valuable information on medicinal plants used in the management of hypertension, part of the plant, method of preparation, dosing, routes of administration, recognized efficacy, and presumed mechanisms of action of some of the medicinal plants. Some of the information obtained from the vendors' corroborated Western scientific data found literature. Phase two (A&B) concentrated on the research questions, which were answered adequately based on the study's findings summarized above.

6.7.4 Phase 3 Development of guidelines for indigenous therapies

The guidelines generated from this study contributed in no small measure to create awareness and provide the scientific knowledge needed by hypertensive patients on how to use medicinal plants, especially when used alongside Western therapies. Reported doses and administration routes are from the research participants, while other information such as active ingredients found in medicinal plants, mechanisms of action, interactions, and toxicities were from literature. Based on the findings of the study's phases and the use of the WHO guidelines, the use of indigenous-western medication to treat hypertension in Belize was developed.

6.7.5 Contribution of this study

Despite the paucity of literature in Belize regarding the use of medicinal plants individually or in combination with Western therapy, this study is groundbreaking in Belize as it forms the baseline knowledge creation. The findings will be disseminated to the ministry of health in Belize to encourage the country to be a World Health Organization member. The country will benefit from developing policies that will regulate the use of indigenous therapies and preserve indigenous plants. The baseline information from this study can contribute to the development of guidelines, including other conditions present in the community.

In conclusion, this study will ensure the trust between the two health-seeking behaviors of the Belizean community.

6.8 LIMITATIONS TO THE STUDY

The researcher recognizes some limitations in conducting this study.

- Both quantitative and qualitative data collection methods were used in conducting this study. The results generated, therefore, provided a significantly rich but large amount of data. Although transparency, honesty, and rigorous data analysis were made, not all the data were discussed in detail. Some aspects of the data were briefly discussed, hoping that more will be discussed during a follow-up study, and during publications, a more detailed explanation may be pursued.
- Information on medicinal plants' interactions and toxicities was found to be in paucity or nonexistent for many of the plants discussed. This paucity of information did not allow for a full presentation on the medicinal plants' guidelines, which was deemed a limitation.
- In the researcher's opinion, the broad objectives of the study were achieved. However, further research on animal studies, pre and post clinic studies on medicinal plants used for managing hypertension needs to be conducted. This approach will address scientific evidence-based information needed for supplemental approval of such medicinal plants.
- During the interview sessions for the qualitative phase, few indigenous therapists had some "secret recipes" for managing hypertension that they did to share. Although he provided information on the available therapies, he did not reveal the secret recipe. Such recipes could not be documented as such, a limitation.
- Finally, because the research was not funded, financial constraints played a bit of limitation where the researcher would have preferred to bring together the indigenous therapists for a focused group discussion rather than individual interviews. To do this will require funds for transportation, refreshments, and honorarium. This was however addressed by the researcher traveling to the individual indigenous therapists.

- Despite these limitations, since the study's overall goal was to generate data from indigenous people and provide guidelines for the use of indigenous-western medications for managing hypertension, the researcher believes the goal was achieved and hence the strength of the study.

6.9 CONCLUDING REMARKS

The use of indigenous-western therapies for managing hypertension in Belize was quantitatively and qualitatively investigated in this study. The study identified the medicinal plants used in managing hypertension, how they are prepared, their recommended dosages, shelf-lives, presumed pharmacology, toxicities, and interactions. From the information gathered, a guideline was provided for medicinal plants used to manage hypertension in Belize. Based on the study results, recommendations have been made for practical actions on the use of medicinal plants in Belize. Indigenous knowledge systems in healthcare in Belize have long been ignored and neglected by the Western healers even though the practice has been in existence from the pre-colonial era. The need for collaboration and mutual respect between indigenous and Western science should be encouraged since both could learn from each other. Indigenous knowledge systems are heavily dependent on indigenous people, and such knowledge is fast disappearing because of a lack of adequate documentation. The present study results significantly serve as documentation for both present and future generations on medicinal plants used in the management of hypertension.

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ANNEXURES

Annexure A: Ethics approval

RESEARCH ETHICS COMMITTEE: DEPARTMENT OF HEALTH STUDIES

REC-012714-039 (NHERC)

1 November 2017

HSHDC/761/2017
Mr Danladi Chiroma Husaini
Student No 6111-327-1
Supervisor: -Dr DD Mphuthi
Qualification:PhD
Joint Supervisor: -

Dear Mr Danladi Chiroma Husaini

Decision: Ethics Approval

Name: Mr Danladi Chiroma Husaini

Proposal: Guidelines on the use of indigenous Western anti-hypertensive therapies in Belize

Qualification: **DPCHS04**

Thank you for the application for research ethics approval from the Research Ethics Committee: Department of Health Studies, for the above mentioned research. Final approval is granted from 1November 2017 to 1 November 2022.

The application was reviewed in compliance with the Unisa Policy on Research Ethics by the Research Ethics Committee: Department of Health Studies on 2 August 2017.

The proposed research may now commence with the proviso that:

1) *The researcher/s will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.*

2) *Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study, as well as changes in the methodology, should be communicated in writing to the Research Ethics Review Committee, Department of Health Studies. An amended application could be requested if there are substantial changes from the existing proposal, especially if those changes affect any of the study-related risks for the research participants.*

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Open Rubric

3) *The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study.*

4) *[Stipulate any reporting requirements if applicable].*

Note:
The reference numbers [top middle and right corner of this communiqué] should be clearly indicated on all forms of communication [e.g. Webmail, E-mail messages, letters] with the intended research participants, as well as with the Research Ethics Committee: Department of Health Studies.

Kind regards,

Prof J.E. Maritz

Prof JE Maritz
CHAIRPERSON
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Annexure B: Participant information letter

Project Title: Guidelines on the use of indigenous-western antihypertensive therapies in Belize.

Please read this consent agreement carefully before you decide to participate in the study.

Purpose of the research study: The study will look at the types of indigenous-western anti-hypertensive therapies used in the management of hypertension in Belize. The study will also find out why, when and how such therapies are used. The study will further develop guidelines for western-indigenous antihypertensive therapies in Belize to promote coexistence of western-indigenous practices.

What you will do in the study: The study will be divided into two phases. You are required to answer the questions as truthful as you can. Any information you provide will be handled with uttermost confidentiality.

Phase one: Please do not write your name or contact address on the questionnaires that will be provided for this phase.

Phase two: This phase you will be requested to be interviewed. The interview will last about 30 minutes.

Risks: There is no known risks associated with this study.

Benefits: There are no direct benefits to you for participating in this research study. The study may help us understand the indigenous – western remedies practices in the management of hypertension. At the end of the study, guidelines for the use of such therapies shall be provided to help the public to improve the quality of life in regards to hypertension management.

Confidentiality:

The information that you give in the study will be handled confidentially. Your data will be anonymous which means that your name will not be collected or linked to the data.

Voluntary participation: Your participation in the study is completely voluntary.

Right to withdraw from the study: You have the right to withdraw from the study at any time without penalty.

If you agree to participate in this study, please sign the consent below.

INFORMED CONSENT

I, (*full name and surname*) ………………………………………………….. the undersigned, have received adequate information and given a chance to ask questions about the nature of research study. My questions have been answered such that I feel comfortable in participating and signing this form. I have read and understand that the following principles:

1) That participation is completely voluntary and there is no pressure
2) That I am free to withdraw from the assignment at anytime without stating reasons
3) That I may not benefit personally from my participation in the assignment although knowledge gained by means of assignment may benefit others or communities.

Participant signature: **Date:**

Witness: Name and Surname:

Signature: **Date:**

Researcher: Name and Surname:

Signature: **Date:**

Annexure C: Information Letter to Participants

Title of Project: Guidelines on the use of indigenous-western antihypertensive therapies in Belize.

Principal Researcher: Danladi Chiroma Husaini
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Supervisor: D. D. Mphuthi (Professor)
Senior Lecturer– Health Studies; College of Human Sciences
Muckleneuk Campus, TvW 7 – 163; **Tel:** 012 429 2058;
mphutdd@unisa.ac.za

You are invited to participate in a study that seeks to provide detailed guidelines on the use of indigenous-western anti-hypertensives therapies in Belize. The study will look at the types of indigenous-western anti-hypertensive therapies used in the management of hypertension in Belize. The provision of the guidelines for western-indigenous antihypertensive usage among hypertensive patients in Belize is an intervention designed to curb public health concerns for western-indigenous practices.

As a participant in this study, you will be asked to complete a questionnaire that is divided into 3 sections. Section one is demographics; section 2 use of antihypertensive medications and section 3 the use of indigenous remedies. For each section you will be required to answer the questions truthfully and to the best of your knowledge.

Participation in this study is voluntary, and will take approximately 30 minutes of your time. By volunteering for this study, you will be helping to provide a national data on indigenous -western therapies used for the management of hypertension in Belize. There are no personal benefits to participation. You may decline to answer any questions presented during the study if you so wish. Furthermore, you may decide to withdraw from this study at any time by advising the researcher, and may do so without any penalty. All information you provide is considered completely confidential; your name will not be included or in any other way associated, with the data collected in the study. Furthermore, because the interest of this study is in the average responses of the entire group of participants, you will not be identified individually in any way in any written reports of this research. Data collected during this study will be retained in a locked office and locked filing cabinet to which only researchers associated with this study have access. Data shall be destroyed in line with approved protocols of the ethics committee. There are no known or anticipated risks associated to participation in this study.

Although this study has been reviewed and approved by the Research Ethics Review Board at UNISA, the final decision about participation is yours. If you have any comments or concerns resulting from your participation in this study, please contact me on +501 622-6176.

Thank you for your assistance in this research project.

Annexure D: Phase 1 - Quantitative data collection questionnaire

COLLECTION TOOL

Phase 1: Quantitative data collection questionnaire

Dear Respondent,

This survey on the *Guidelines on the use of indigenous-western therapies in the treatment of hypertension in Belize* is conducted with a view to assess the practice of indigenous-western therapies use in treating hypertension in Belize. Your participation in this survey will help to provide a national data in this area and contribute to the development of a national guideline on indigenous-western therapies use in the management of hypertension. Your participation is voluntary and at any point you may wish to withdraw from completing this survey.

Thank you.

Section 1: Demographics

1. Your age in years

   □ 18 – 30yrs

   □ 31 – 40 yrs.

   □ 41 – 50 yrs.

   □ 51- 60 yrs.

   □ 58 – 62 yrs.

2. Gender

   □ Male □ Female

3. Marriage status

   □ Married

   □ Separated

   □ Divorced

   □ Widow

   □ Single

4. Religious affiliation

   □ Catholic

   □ Evangelicals (Baptist, Methodist, SDA etc.)

   □ Pentecostals

   □ Rastafarian

   □ Traditional

   □ Other (specify) ___________________

5. Education

   □ No formal education

   □ Primary

   □ Secondary

   □ Tertiary (undergraduate)

   □ Postgraduate (Masters, PhD)

6. Employment

   □ Self employed

   □ Public service

   □ Private sector

   □Not employed

   □ Retired

7. District

   □ Belize

   □ Cayo

   □ Corozal

   □ Orange Walk

   □ Stan Creek

   □ Toledo

8. Ethnicity

□ Creole

□ Hispanic

□ Garinagu

□ Mestizo

□ Maya

□ European/North American

□ Other (specify) ___________________________

9. Monthly income (Belizean Dollars)

□Less than $200

□$201 – 500

□$501 – 1000

□$1001 - 2000

□$2001 and above

Section 2: Hypertension history/adherence

1. How long since you became aware that you have high blood pressure?

□ 1- 5 years

□ 6 – 10 years

□ 11 – 15 year

□ 16 – 20 years

□ 21 years and above

2. How long have you been taking drugs to treat your blood pressure?

□ 1- 5 years

□ 6 – 10 years

□ 11 – 15 year

□ 16 – 20 years

□ 21 years and above

3. How often do you take your prescribed drugs/medicines for high blood pressure?

   □ Once daily

   □ Twice daily

   □ Thrice daily

   □ Four times daily

4. What blood pressure medicines (pressure pill) are you currently taking? (check all that applies)

   □ Hydroclorothiazide (Water pill)

   □ Atenolol (Tenormin)

   □ Metoprolol (Toprol)

   □ Amlodipine (Norvasc)

   □ Lorsartan (Cozaar)

   □ Lisinopril (Prinivil)

   □ Others (please specify) ____________________________

5. When you feel like your blood pressure is under control, do you sometimes stop taking your drugs/medicine?

   □ Yes

   □ No

6. How often did you stop taking your blood pressure medicines in the PAST 30 DAYS?

   □ Just once (in the past 30 days)

   □ More than 5 times (in the past 30 days)

   □ More than 5 times a month (in the past 30 days)

   □ More than 5 times a week (in the past 30 days)

   □ Every day (in the past 30 days)

   □ Never stopped taking my blood pressure medications (in the past 30 days)

7. Do you sometimes forget to take your blood pressure medicines?

□ Yes

□ No

8. When you travel or leave home, do you sometimes forget to take along your blood pressure medicines?

□ Yes

□ No

9. Have you ever cut back or stopped taking your antihypertensive medicines without telling your doctor because you felt worse when you took it?

□ Yes

□ No

10. Taking medicines every day is a real inconvenience for some people. Do you ever feel hassled (stressed) about sticking to your treatment plan?

□ Yes

□ No

Section 3: Herbal/bush-drug prevalence and usage

11. Do you know anyone who uses herbal/bush remedies to treat their disease?

□ Yes

□ No

12. Do you know of any herbal/bush remedies used to treat high blood pressure in Belize?

□ Yes

□ No

if No, skip to 15

13. What are the names of these herbal/bush remedies used to treat high blood pressure?

    a. ______________________________
    b. ______________________________
    c. ______________________________
    d. ______________________________
    e. ______________________________

14. What are (or do you know) some of the reasons why people take herbal/bush remedies in Belize?

    □ It's safer
    □ It is cheaper
    □ It is readily available
    □ Religious reasons
    □ It is natural

15. Do you take herbal/bush remedies to treat diseases other than hypertension?

    □ Yes
    □ No

16. Do you take herbal/bush remedies to treat your high blood pressure?

    □ Yes
    □ No

If no skip to 32.

17. Name the herbal/bush remedies you take to treat your high blood pressure?

    a. ______________________________
    b. ______________________________
    c. ______________________________
    d. ______________________________
    e. ______________________________

18. How often have you used herbal/bush remedies in the PAST 12 MONTHS to treat your high blood pressure?

□ Just once (in the past 12 months)

□ More than 5 times (in the past 12 months)

□ More than 5 times a month (in the past 12 months)

□ More than 5 times a week (in the past 12 months)

□ Every day (in the past 12 months)

19. Do you take herbal remedies alone or together with your prescribed blood pressure medications?

□ Herbal/bush remedies alone (no drugs)

□ Herb/bush remedies with drugs together (concomitant)

□ Sometimes herbal alone and sometimes in combination

□ I do not combine herbs with drugs. Medications alone without herbs

If no combination skip to 26

20. Why do you take herbal/bush remedies together with your blood pressure drugs?

□ They work well together

□ Pharmaceutical drug alone not good

□ Too many side effects with pharmaceutical drug

□ Pharmaceutical drug expensive

□ No harm in taking both together

□ Not taking pharmaceutical drug for same condition

21. Do you think combining herbal/bush remedies with your prescribed blood pressure drugs can help lower your pressure more quickly than drugs alone?

□ Yes

□ No

22. Are you aware of possible interactions that might occur between herbal/bush remedies and prescribed medications when taken together?

□ Yes

□ No

23. Did your medical practitioner/doctor ask if you use herbal/bush remedies together with your anti-hypertensive drugs?

□ Yes

□ No

24. Did you inform your medical practitioner/doctor that you use herbal/bush remedies together with your prescribed antihypertensive medications?

□ Yes

□ No

If yes skip to 26

25. Why didn't you inform your medical practitioner that you are taking herbal/bush remedies together with your prescribed medication?

□ Didn't think it was important

□ He/she didn't ask me

□ I wasn't aware that I should inform him/her

□ Doctors don't like herbal/bush remedies

□ I didn't want doctor to stop me from taking them

26. What is the source of your herbal/bush remedies?

□ Grocery stores/super market

□ Bush doctor

□ My yard

□ Herbal shop/store/market

□ Family

□ Friends

Please provide information on how you prepare your herbal/bush remedies for hypertension (if you don’t buy ready made).

27. Which part of the plant/herbal medication do you use to treat your high blood pressure?

□ Leaves

□ Roots

□ Stem

□ Combination of all

28. How do you prepare the herbal medication for use?

□ Boiling them and drinking the tea

□ Infusion after pooling

□ Chewing

□ Sniffing

30. Do you consider herbs/bush remedies better than prescribed/conventional drugs/medications?

□ Yes

□ No

31. Why do you prefer herbs to pharmaceutical medications?

□ Pharmaceutical medications are expensive

□ Hospitals waste too much time

□ Herbs are natural

□ Herbs are readily available

□ Herbs are safe and cause no harm

□ I don’t like health workers (doctors/nurses)

32. Why don't you take herbal preparations for the management of your hypertension?

Thank you for your time.

Danladi Husaini (Researcher)

Annexure E: Phase II Interview guide for hypertensive patients

Phase II Interview guide for hypertensive patients

INTRODUCTION:

- Introduction and welcome.
- Informs the participants about the use of the audio-tape during the discussion.
- Participants are informed about the confidentiality as well as the no name use during the interview and their names will not be reflected in the transcribed text.
- Consent forms discussed and signed by participants.

INTERVIEW SESSION

Good day and welcome to this session. Thank you for taking time to come and join me in this interview. The information will be used for research purposes only. There are no wrong answers to the questions therefore feel free to express your views. Feel free to share with me your experiences and knowledge regarding the use of herbal remedies for the treatment of hypertension. **No names** will be written in the research transcripts as well as report. You are assured of complete **confidentiality.**

RESEARCH QUESTIONS:

"Can you please tell me which indigenous therapies you use to treat your high blood pressure and how do you prepare them?"

Probing questions

1. How long have you been taking indigenous therapies?
2. Why do you take herbal remedies for your hypertension? [Reasons for use]
3. How did you learn about the use of indigenous therapies in the treatment of hypertension?
4. How effective have these therapies been in the management of your hypertension?

5. Does your therapy cure hypertension or just controls it?
6. How long the therapy should be taken for cure to take place or for the pressure to be under control?
7. Do you combine your indigenous therapy with Western medicines? If yes why? And if no why?
8. Have you experienced any sort of side effects while taking herbs for your hypertension?
9. How much do you spend on such remedies for your hypertension?

Closing the interview:

Is there anything else that you would like to add that you think may help me to understand the reasons for the usage of indigenous remedies?

Thank the participant once more for their time and the session closes.

Annexure F: Phase II Interview guide for vendors of indigenous therapies

INTRODUCTION:

- Introduction and welcome.
- Informs the participants about the use of the audio-tape during the discussion.
- Participants are informed about the confidentiality as well as the no name use during the interview and their names will not be reflected in the transcribed text.
- Consent forms discussed and signed by participants.

INTERVIEW SESSION

Good day and welcome to this session. Thank you for taking time to come and join me in this interview. The information will be used for research purposes only. There are no wrong answers to the questions therefore feel free to express your views. Feel free to share with me your experiences and knowledge regarding the use of herbal remedies for the treatment of hypertension. **No names** will be written in the research transcripts as well as report. You are assured of complete **confidentiality.**

RESEARCH QUESTIONS:

"Can you please tell me which indigenous therapies you recommend to treat the high blood pressure and how it should be prepared by the persons taking them?"

Probing questions

1. For how long have you been selling indigenous therapies?
2. How did you learn the use of indigenous therapies?
3. What indigenous therapies do you recommend for the treatment of hypertension?
4. How do you get the indigenous therapies for hypertension?
5. What part of the indigenous therapy (example plant) do you use or recommend for hypertension?
6. How is the preparation to be taken for the management of hypertension?
7. How long should the preparation stay after preparation? (shelf life)
8. Does the herb cure hypertension or just lower the pressure?

9. What is the average cost of a regimen for hypertension?

Closing the interview:

Is there anything else that you would like to add that you think may help me to understand the reasons for the usage of herbal remedies?

Thank the participant once more for their time and the session closes.

Annexure G: Phase III guidelines development

Information to be included in the guidelines for the use of indigenous-western therapies for hypertension in Belize.

- Scientific name of plant/herb.
- Local name (s) of plant/herb.
- Part of plant used for hypertensive management.
- Picture of herb/plant.
- Habitat/how herb can be found or purchased.
- How herb is prepared and taken.
- Indication (s) for therapy.
- Proposed mechanism of action.
- Efficacy of herb.
- Side effects of herb.
- Possible interactions with western remedies.
- Possible contraindications.
- Any warning.
- Any other useful information.